INVITATION TO BID
BID #045-026

CITY OF LUCAS, TEXAS
BIDS WILL BE ACCEPTED AT CITY HALL

(West Lucas Road Reconstruction and Widening)

BID PACKAGES ARE DUE TO THE
PURCHASING DIVISION PRIOR TO:

June 5th, 2026 TIME AT 2:00 PM CST

NO LATE BIDS WILL BE ACCEPTED
FACSIMILE BIDS WILL NOT BE ACCEPTED

ELECTRONIC RESPONSES ARE ENCOURAGED

PROPOSAL PACKAGES
MAY BE DELIVERED OR MAILED TO:

CITY OF LUCAS
PURCHASING BID #045-26
(WEST LUCAS ROAD RECONSTRUCTION AND WIDENING)
665 COUNTRY CLUB ROAD
LUCAS, TX 75002-7651

FOR ADDITIONAL INFORMATION CONCERNING THIS PROPOSAL
PLEASE CONTACT:

Purchasing Coordinator Linezka Maduro at lmaduro@lucastexas.us

TABLE OF CONTENTS

SECTION I NOTICE TO BIDDERS

SECTION II GENERAL TERMS AND CONDITIONS

SECTION III SPECIAL CONDITIONS

SECTION IV SPECIAL SPECIFICATIONS

SECTION V BID SCHEDULE OF VALUES AND BID ENDORSEMENTS

SECTION VI REQUIRED FORMS (SUBMIT AT BID):

- BID ENDORSEMENT
- CERTIFICATE OF INSURANCE (SAMPLE)
- AFFIDAVIT OF NO PROHIBITED INTEREST
- BIDDERS QUALIFICATION STATEMENT
- SUPPLEMENTAL INFORMATION
- CONFLICT OF INTEREST QUESTIONNAIRE
- SCHEDULE OF SUBCONTRACTORS
- WORKFORCE COMPOSITION
- BID PROPOSAL
- STANDARD FORM OF AGREEMENT
- BID BOND

SECTION VII FORMS DUE AFTER AWARD

- PERFORMANCE BOND
- PAYMENT BOND
- MAINTENANCE BOND
- VENDOR REGISTRATION FORM
- CERTIFICATE OF INTERESTED PARTIES (1295)
- CITY OF LUCAS CONTRACTOR INSURANCE REQUIREMENTS AND AGREEMENT
- INSURANCE BINDER
- CONTRACTORS AFFIDAVIT OF BILLS PAID
- CITY OF LUCAS PUBLIC WORKS STANDARD CONTRACT SAMPLE
- DAVIS-BACON WAGE RATES

ATTACHMENTS

A. SOLARAY ENGINEERING SUBSURFACE UTILITY ENGINEERING REPORT – WEST LUCAS ROAD ROADWAY IMPROVEMENTS
DATED MARCH 18, 2022

B. TERRACON GEOTECHNICAL ENGINEERING REPORT – WEST LUCAS ROAD RECONSTRUCTION AND WIDENING
PROJECT NO. 94215036
DATED OCTOBER 7, 2021

C. BCC ENGINEERING FINAL PLANS – WEST LUCAS ROAD RECONSTRUCTION AND WIDENING
DATED APRIL 7, 2026

SECTION I

NOTICE TO BIDDERS

DAVIS-BACON WAGE RATES

SECTION VI FORMS DUE AFTER AWARD/PRIOR TO CONTRACT EXECUTION

1. EXAMPLE FORMS

SECTION I
NOTICE TO BIDDERS

1.1 INTRODUCTION

Section I provides general information to potential proposers on subjects such as where to submit proposals, number of copies, amendments, proprietary information designation, and other similar administrative elements.

1.2 SUBMISSION OF BID/PROPOSAL

Electronic responses are the preferred method of receiving responses for this solicitation. However, all methods detailed in this solicitation are acceptable. All bids/proposals will be received by the City of Lucas Purchasing Office. If proposer submits a hard copy, bids/proposals shall be in one envelope clearly marked with the Bid Number on the outside of the envelope containing the bid/proposal.

INVITATION FOR BID #045-26

WEST LUCAS ROAD RECONSTRUCTION AND WIDENING (Base and Add Alternative 1)

Electronic bids/proposals are to be submitted to lmaduro@lucastexas.us

Sealed bids/proposals are to be submitted to:

CITY OF LUCAS PURCHASING
RE: BID #045-26
665 COUNTRY CLUB ROAD
LUCAS, TX 75002-7651

NO LATE BIDS/PROPOSALS WILL BE ACCEPTED
FACSIMILE BIDS/PROPOSALS WILL NOT BE ACCEPTED

Bid Deadline June 5th, 2026 2:00 P.M. Central Time
Promptly thereafter, all Bids/Proposals that have been duly received will be publicly opened and read aloud in the Council Conference Room, City Hall.

Plans, specifications and bid documents may be downloaded for the City of Lucas website: https://www.lucastexas.us/bid-postings.

1.3 PRE-BID CONFERENCE

A **Pre-Bid Conference** will be held for the above project at Lucas City Hall, 665 Country Club Road, Lucas, TX 75002 at **10:00 A.M., (May 26, 2026)**.

1.4 NUMBER OF COPIES

Electronic submission is recommended. If the proposer chooses to submit a hard copy bid, Bidder/Proposer shall submit one (1) original set and **ONE (1)** copy of proposal documents. This will greatly facilitate the evaluation process. The proposal shall remain the property of the City of Lucas. The original copy shall be unbound and clearly marked "Original".

1.5 BID/PROPOSAL INFORMATION

All questions regarding bid/proposal preparation, selection process, specifications and interpretations of the terms and conditions of the bid/proposal shall be submitted in writing to Purchasing Coordinator Linezka Maduro at lmaduro@lucastexas.us. Any addenda will be issued no later than three (3) calendar days prior to the deadline for submission of bids.

1.6 PREVAILING WAGE RATES

Attention is called to the fact that the Contractor must pay labor on this project not less than the general prevailing rates of wages, which have been established for Collin County and attached herein for reference.

As stated in the *Texas Government Code*, Title 10, Subtitle F, Chapter 2258, Subchapter B:

Sec. 2258.021. RIGHT TO BE PAID PREVAILING WAGE RATES.

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:

(1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and

(2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

1.7 DISCLOSURE OF RESPONSE

All information submitted in an accepted response must be retained by the City of Lucas for the period specified in the City of Lucas's record retention schedule created under Government Code Section 441.180, et sequitur. The information will not be returned to the respondent. The Public Information Act (PIA), Government Code Chapter 552, allows the public to have access to information in the possession of a governmental body through an open records request. Therefore, the respondent shall clearly identify in the response any confidential or proprietary information. Proprietary information identified by the respondent in the response, will be kept confidential by the City of Lucas to the extent permitted by state law. The City of Lucas merely raises the exception on behalf of the vendor. The City of Lucas takes no legal position on disclosure. The City of Lucas will use best efforts to give the respondent or the awarded vendor an opportunity to present to the Office of the Attorney General its arguments for non-disclosure of its identified confidential or proprietary information.

DISCLOSURE OF INTERESTED PARTIES

Texas Legislature passed HB 1295 that now requires a government entity receive a Disclosure of Interested Parties (Form 1295) before entering into a contract with a vendor that requires action by the City Council. Form 1295 was created by the Texas Ethics Commission per the direction of the Texas Legislature. The form must be completed electronically on the Texas Ethics Commission website, https://www.ethics.state.tx.us. Once you have electronically completed the form, you must print the form, sign & notarize the form, then deliver the form to the

City of Lucas along with the executed contract. This will apply to contracts that will require Council approval, in most situations will be $50,000 or greater.

1.8 ADDENDUMS/AMENDMENTS

Any interpretations, corrections and/or changes to a bid/proposal solicitation or extensions to the opening date will be made by addenda to the respective document when necessary. An addendum will be published and distributed by email to all that are known to have received a copy of the bid/proposal and related specifications. However, it shall be the sole responsibility of the bidder/proposer to verify issuance/non-issuance of addenda and to check all avenues of document availability prior to opening date and time to ensure bidder's receipt of any addenda issued. No addenda will be issued 3 days prior to bid opening. The last day for questions will be on **Monday, June 1, 2026 at 2:00 PM**. The last day for addenda will be on **Monday. June 1, 2026 at 2:00 PM**.

Any addenda issued within three working days of the bid opening will automatically delay the bid opening by one week. Bidders that attended the pre-bid meeting will be notified of the new bid opening time and date as determined by the City of Lucas Purchasing. The new bid date will also be posted on the city website.

The bidder is required to acknowledge receipt of any amendments by submitting a signed copy of each amendment issued. Signed copies must be submitted as part of the signed bid/proposal submittal.

1.9 BID SUBMITTALS

Bids/Proposals shall be submitted on the forms provided to insure complete uniformity of wording of all bids. All lump sum and unit prices must be stated in both script and figures. Bids may be rejected if they show any omissions, alterations in wording, conditional clauses, or irregularities of any kind.

If an emergency or unanticipated event interrupts normal City processes so as to cause postponement of the scheduled bid opening, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal City processes resume or to such other date and time as may be provided on the city website.

1.10 BIDDING ALTERNATES

Alternatives to manufacturer-specified equipment or materials must be pre-approved in writing prior to bid opening.

1.11 ACCEPTANCE

Any offer received shall be considered an offer, which may be accepted by the City of Lucas based on initial submission without discussions or negotiations. By submitting an offer in response to this solicitation the bidder/proposer agrees that any offer it submits may be accepted by the City of Lucas at any time within 90 days from the close date.

The City of Lucas reserves the right to reject any or all offers and to waive informalities and minor irregularities in offers received, and/or to accept any portion of the offer if deemed in the best interest of the City of Lucas. Failure of the bidder/proposer to provide in its offer any information requested in the bid may result in rejection for non-responsiveness.

1.12 REQUIRED FORMS TO BE RETURNED WITH BID SUBMITTAL

a. Certificate of Insurance
b. Affidavit of No Prohibited Interest
c. Bidders Qualification Statement with three references
d. Supplemental Information
e. Conflict of Interest Questionnaire
f. Schedule of Subcontractors
g. Workforce Composition
h. Bid Schedule
i. Bid Endorsement Page

j. Standard Form of Agreement
k. Bid Bond for 5% of total project due with bid submittal

1.13 COMMENCEMENT OF WORK

The Contractor agrees to commence work within (10) days after the date of written Notice to Proceed.

1.14 REQUIRED BONDS

The following bonds are required prior to contract execution OR project acceptance:

- Bid Bond – due with bid submittal
- Payment Bond – due prior to contract execution
- Performance Bond – due prior to contract execution
- Maintenance Bond to be executed at final acceptance for two (2) years and 100% of project total

1.15 AWARD

The City of Lucas intends to make an award using the evaluation criteria and other factors as indicated in this bid/proposal. The award shall be based on the lowest responsible and best-qualified bidder whose evaluation by the City of Lucas indicates to be in the best interest of the City and taxpayers.

Bid will be awarded on the basis of "best value". The award to the successful bidder will be determined by best value to the City of Lucas as allowed by Chapter 252 of the Local Government Code. The following criteria will be considered when selecting the successful bidder:

- the purchase price
- the reputation of the bidder and the bidder's services;
- the quality of the bidder's service;
- the extent to which the bidder's services meet the City's needs;
- the bidder's past business relationship with the City;
- the impact on the ability of the City to comply with laws and rules relating to contracting with historically underutilized businesses and non-profit organizations employing persons with disabilities;
- the total long-term cost to the City to acquire the bidder's goods or services; and
- any relevant criteria specifically listed in the request for bids or proposals.

1.15.1 Factors for consideration in the evaluation process:

Invitation for Bid (Contract for Goods and Services)

For projects with a requirement of CALENDAR DAYS TO COMPLETE PROJECT and/or TOTAL BID AMOUNT, the city will use the following schedule as the monetary value of a calendar day:

Amount of Contract ($)	**Value of a Calendar Day ($)**
Less than 25,000	100 per day
25,000 to 99,999.99	160 per day
100,000 to 999,999.99	240 per day
1,000,000 to 1,999,999.99	500 per day
2,000,000 to 2,999,999.99	1,000 per day
3,000,000 to 3,999,999.99	1,500 per day

4,000,000 to 4,999,999.99	2,000 per day
5,000,000 to 5,999,999.99	2,500 per day
6,000,000 to 6,999,999.99	3,000 per day
7,000,000 to 7,999,999.99	3,500 per day
8,000,000 to 8,999,999.99	4,000 per day
9,000,000 to 9,999,999.99	4,500 per day
10,000,000 to 10,999,999.99	5,000 per day
11,000,000 to 11,999,999.99	5,500 per day
More than 12,000,000.00	6,000 per day

Bidders should be aware that the evaluation for the award may consider the number of days bid. The value of the day will be determined by the lowest days bid and the corresponding value of the contract. The difference in the number of days will be multiplied by the calendar day value and added to each bidder's base bid. This is also sometimes referred to as 'A+B' bidding.

1.16 LIQUIDATED DAMAGES

Bidders should be aware that the City of Lucas expects timely completion of the contract within the timeframe indicated by the bidder in their bid. Consequently, bidders should be aware that the following schedule will be applied by the City as liquidated damages for each day the project is delayed in completion:

Amount of Contract ($)	**Value of a Calendar Day ($)**
Less than 25,000	100 per day
25,000 to 99,999.99	160 per day
100,000 to 999,999.99	240 per day
1,000,000 to 1,999,999.99	500 per day
2,000,000 to 2,999,999.99	1,000 per day
3,000,000 to 3,999,999.99	1,500 per day
4,000,000 to 4,999,999.99	2,000 per day
5,000,000 to 5,999,999.99	2,500 per day
6,000,000 to 6,999,999.99	3,000 per day
7,000,000 to 7,999,999.99	3,500 per day
8,000,000 to 8,999,999.99	4,000 per day
9,000,000 to 9,999,999.99	4,500 per day
10,000,000 to 10,999,999.99	5,000 per day
11,000,000 to 11,999,999.99	5,500 per day
More than 12,000,000.00	6,000 per day

Note: The sum of money thus deducted for such delay, failure, or noncompletion is not to be considered as a penalty, but shall be deemed, taken and treated as reasonable liquidated damages, per day that the contractor shall be in default after the time stipulated in the contract for completing the work.

1.17 RETAINAGE

As security for the faithful completion of the work by the contractor, the owner shall retain ten percent (10%) of the total dollar amount of work done on all contracts less than $400,000; five percent (5%) of the total dollar amount of work done on all contracts of $400,000 or more. Retainage will be held from each progress payment/invoice through final project completion/closeout.

1.18 BID TABULATIONS

Bid tabulations can be accessed in the City of Lucas Website: https://www.lucastexas.us/bid-postings.

1.19 CONTRACT ADMINISTRATION

The Lucas City Engineering together with the Finance Director shall be responsible for administration of the contract for compliance with the interpretation of scope, schedule, billings, requirements, and budget.

1.20 SUBSTANTIVE PROPOSALS

The respondent shall certify (a) that his bid submittal is genuine and is not made in the interest of, or on behalf of, any undisclosed person, firm, or corporation; (b) that he/she has not directly or indirectly induced or solicited any other respondent to put in a false or sham bid; (c) that he/she has not solicited or induced any other person, firm, or corporation from proposing; and (d) that he/she has not sought by collusion to obtain for himself any advantage over any other respondents or over the City of Lucas.

Bidder shall sign and return a copy of the Standard Form of Agreement.

Bidders must submit a Cashier's or Certified Check, issued by a bank satisfactory to the City of Lucas, or a Bid Bond issued by a bonding company satisfactory to the City of Lucas, payable without recourse to the order of the City of Lucas in an amount not less than five percent (5%) of the largest possible bid submitted as a guaranty that Bidder will enter into a contract and execute Bond and Guaranty. Bids without required check or bid bond will be considered non-responsive.

Minimum standard for responsible prospective bidders are as follows:

- Have adequate financial resources, or the ability to obtain such resources
- Be able to comply with the required or proposed schedules and project requirements
- Competitive pricing
- Have a satisfactory record of performance for contracts of similar scope (complete attached reference sheet)
- Have a satisfactory record of integrity and ethics
- Completeness and thoroughness of bid submittal

The City of Lucas may make such investigations as it deems necessary to determine the ability of the bidder to provide satisfactory performance in accordance with bid requirements, and the respondent shall furnish to the City all such information and data for this purpose.

1.21 DEFINITIONS

Bidder refers to submitter.

Vendor refers to Successful Bidder or Contractor.

Submittal refers to those documents required to be submitted to the City of Lucas, by a bidder.

1.22 INQUIRIES

Questions resulting in changes to this solicitation will be provided in the form of an amendment to the solicitation. Questions about this bid shall be in writing and directed to Purchasing Coordinator Linezka Maduro at the following address or email: 665 Country Club Road, Lucas, TX 75002-7651, lmaduro@lucastexas.us.

1.23 SCHEDULE OF EVENTS

The upcoming schedule of events is tentative scheduled as follows:

Public Advertisements		Friday, May 15, 2026 Friday, May 22, 2026 Friday, May 29, 2026
Pre-Bid Conference	May 26. 2026	at 10:00 AM
Open Bids	June 5, 2026	at 2:00 PM
Council Awards Contract (Anticipated)		Thursday, June 18, 2026
Notice of Award (Anticipated)		Monday, June 22, 2026
Notice to Proceed (Anticipated)		Monday, July 6, 2026
Finish Construction		As determined by Contractor's proposal. Calendar Days following official written Notice to Proceed.

SECTION II

GENERAL TERMS AND CONDITIONS

SECTION II
GENERAL TERMS & CONDITIONS

The City of Lucas bid packets contain various sections requiring completion. The bid form section of the bid packet must be completed prior to the date and time set for bid opening and included with the bid packet or the vendor will be found non-responsive.

2.1 These instructions apply to all quotations or bid submittals and become a part of terms and conditions of any bid packet submitted.

2.2 The City shall have the authority to disapprove or reject unsatisfactory work, services or equipment. If required by the City, the vendor shall promptly, as directed, correct all unsatisfactory work and replace all defective equipment, and shall bear all direct, indirect and consequential costs of such correction.

2.3 The City reserves the right to waive any minor defect, irregularity, or informality in any bid, quotation, or proposal. The City may also reject any or all bids, quotations, or proposals without cause prior to award.

2.4 The City reserves the right to enforce the performance of this contract in any manner prescribed by law and deemed to be in the best interest of the City in the event of breach or default of this contract. The City reserves the right to terminate the contract immediately in the event the vendor fails to meet schedules or otherwise perform in accordance with these specifications. Breaches of contract or default authorize the City to purchase the services from the next low bidder or re-bid and charge the difference in cost to the defaulting vendor.

2.5 The contract shall remain in effect until contract expires, except for breach of contract, or is terminated by either party with a thirty (30) day written notice prior to any cancellation. The vendor shall state therein the reasons for such cancellation. Notice of termination must be transmitted via certified mail to the other party's designated representative.

2.6 The vendor shall be held responsible for and shall make good, without expense to the City, any and all damage, injury or loss due to the execution of his work. The vendor shall protect all finished building surfaces from damage and shall repair any damage to the building or property caused by delivery or installation of product.

2.7 The vendor agrees to indemnify and hold harmless the City against all claims or alleged claims or demands for damages, including all expenses incurred, arising from accidents to employees of either party hereto or to the public, or from claims or alleged claims of damages to the property of the City or to adjoining property caused directly or indirectly by said vendor, by any of his subcontractors, or by anyone directly or indirectly employed by either of them in connection with the performance of this contract.

2.8 The vendor agrees to indemnify and hold the City harmless from any claim involving patent right infringement or copyrights on goods supplied.

2.9 In its sole discretion, the City shall have the right to select or to approve defense counsel to be retained by Contractor in fulfilling its obligation hereunder to defend and indemnify City, unless such right is expressly waived by City in writing. City reserves the right to provide a portion of its own entire defense; however, City is under no obligation to do so, any such action by City is not to be construed as a waiver of Contractor's obligation to defend City or as a waiver of contractor's obligation to indemnify City pursuant to this contract. Contractor shall retain City approved defense counsel within seven (7) business days of City's written notice that City is invoking its right to indemnification under this contract. If Contractor fails to retain counsel within such time period, City shall have the right to retain defense counsel on its own behalf, and contractor shall be liable for all costs incurred by City.

2.10 The vendor shall not sell, assign, transfer or convey this contract, in whole or in part, without the prior written consent of the City.

2.11 This bid, when properly accepted by the City, shall constitute a contract equally binding between the vendor and the City. No different or additional terms shall become a part of this contract with the exception of a change order processed through the Engineering Department.

2.12 This agreement will be governed and construed according to the laws of the State of Texas. This agreement is performable in Collin County, Texas.

2.13 The successful bidder and the City of Lucas agree that each party have rights, duties, and remedies available as stated in the Uniform Commercial Code and any other available remedy, whether in law or equity.

2.14 Bidder acknowledges and represents that they are aware of laws, City Charter and City Code of Conduct regarding Conflicts of Interest. The City Charter states that "no officer or employee of the City shall have a financial interest, direct or indirect, in any contract with the City, nor shall be financially interested, directly or indirectly, in the sale to the City of any land or rights or interest in any land, materials, supplies or service…"

2.15 Chapter 176 of the Texas Local Government Code requires that any vendor or person considering doing business with a Local Government entity, disclose in the questionnaire form CIQ, the vendor or person's affiliation or business relationship that might cause a Conflict of Interest. This form must be filed with the Records Administrator no later than 7 business days after the date the person becomes aware of facts that require the statement to be filed. A person commits an offense if the person violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

2.16 All equipment, supplies and work furnished under this contract shall comply with applicable laws, ordinances and regulations unless otherwise provided in the Contract.

2.17 The Vendor shall obtain and pay for such permits and inspections as are required for the legal performance of this work at Vendor's expense, unless otherwise provided in the contract document.

2.18 The City reserves the right to audit the records and performance of vendor during the term of the contract and for three years thereafter.

2.19 Unless otherwise notified, all invoices must be sent to the Accounts Payable, Finance Department at the address listed on page one (1). Invoices must show the item(s) shipped/work performed and the purchase order number applicable to the transaction in order to insure prompt payment.

2.20 Payment will be made in accordance with Texas statues. Term of Payment is net 30 days after the date the City receives the goods in accordance with the contract, the date the performance of service in accordance with the contract is completed, or the date the agency receives an approved invoice for the goods or services, whichever occurs the latest. If your company provides a discount for early payment, please indicate in this solicitation. This will not be considered an evaluation factor in the award of the bid(s).

2.21 The City of Lucas is by statute tax-exempt therefore pricing shall not include taxes. Tax exemption certificates will be executed by the City and furnished upon request.

2.22 Vendors shall state a firm completion time. The City reserves the right to cancel orders and/or assess financial penalties if the vendor fails to complete project as promised. Work shall be scheduled between 8:00 a.m. and 5:00 p.m. (7:00 a.m. to 6:00 p.m. for Construction Contracts in the public right of way), Monday through Saturday, excluding holidays, unless otherwise approved by the City.

2.23 When offering products other than those bid, the City reserves the right to request a sample/demo of the product for evaluation. In such cases, the bidder must provide a sample/demo of the product at no charge to the City within three days of the request, and must pick up the product after the evaluation. Failure to provide an evaluation product within the three day period will disqualify the bidder from further consideration. If the bidder offers a product other than that specified, specifications must be included in the bid package. Bid responses not listing manufacturer or part numbers in the Mfg./Pt No. section of the bid form will be considered as bidding according to specification, and if awarded, will be required to provide exactly what was specified. Samples should not be enclosed with bid unless requested.

2.24 The apparent silence of these specifications as to any detail or to the apparent omission from it of a detailed description concerning any point, shall be regarded as meaning that only the best commercial practices are to prevail. All interpretation of these specifications shall be made on the basis of this statement.

2.25 When unit price differs from extended price, the unit price prevails.

2.26 In case of a discrepancy between the product number and description, the description takes precedence.

2.27 When manufacturers are named in the specification, they are not meant to limit competition, but to define the minimum standard, quality, and performance of the item specified. All materials supplied will be new, first quality industrial-grade products. Alternatives to manufacturer specified equipment or materials must be pre-approved in writing prior to the last day for addenda (see Invitation to Bidders).

2.28 Response to specification is primary in determining the lowest responsible bid.

2.29 The City of Lucas reserves the right to award a vendor's bid as an "alternate award". The alternate vendor's bid shall remain in effect for the term of the awarded contract, should the primary vendor become unable or unwilling to complete the contract term. The alternate vendor will be notified in writing of their official contract and start date. All terms and conditions of the original bid will remain in effect.

2.30 Bid prices cannot be altered or amended after submission deadline. Any interlineations, alteration, or erasure made before opening time must be initialed by the signer of the bid, guaranteeing authenticity.

2.31 A bid price may not be withdrawn or canceled by the bidder for a period of 90 days following the date designated for the receipt of bids without written approval of the Purchasing Manager, and bidder so agrees upon submittal of bid.

2.32 No oral statement of any person shall modify or otherwise change or affect the terms, conditions or specifications stated in the resulting contract. All change orders must be made in writing.

2.33 Any interpretations, corrections or changes to this bid packet will be made by addenda. Sole issuing authority shall be vested in the City of Lucas Purchasing Department. Addenda will be sent to all who are known to have received a copy of this bid packet. If the Addenda contain changes to the specification or bid form, bidders shall acknowledge receipt of all addenda or they will be declared non-responsive.

2.34 All work, materials, equipment, and supplies, furnished under this contract shall comply with applicable laws, ordinances and regulations.

2.35 Unless otherwise indicated, items will be new, unused, and in first rate condition in containers suitable for damage-free shipment and storage.

2.36 Quotations must show the number of calendar days required to place the materials in the possession of the City. Do not quote shipping dates.

2.37 F.O.B. will be Destination/Inside Delivery/Installed at the location stated on the City's purchase order, acceptable only during normal working hours. The price will be firm lump sum all-inclusive cost for all materials, work, transportation, and all other costs of whatsoever nature for each item listed. Vendor will be responsible for all claims against the carrier for all freight and/or drayage damage. The City assumes no liability for goods delivered in damaged or unacceptable condition. Vendor shall handle all claims with carriers, and in case of damaged goods, shall ship replacement goods immediately upon notification by District of damage. Shipments will be made to the specific locations described in the bid specifications. If the vendor must deliver to the specified room, the vendor must remove all packing and debris, which results from set-up and installation. Owner dumpsters cannot be used.

2.38 At the time of the opening of bids each bidder shall be presumed to have inspected the sites and to have read and shall be thoroughly familiar with the contract requirements. The failure or omission of any bidder to examine any form, instrument, document or site shall in no way relieve any bidder from any obligation in respect to this bid.

2.39 The City shall have the right to do other work, or to let other contracts for work to be done, on the same sites as specified for the work to be done under this contract, and the City's arrangements as to precedence of work and the relationship between the Vendor and the City shall be decisive.

2.40 It is the policy of the City of Lucas that whenever practical, products should be purchased which contain the highest percentage of post-consumer recovered material available in the marketplace and/or the highest percentage of pre-consumer recovered material available in the marketplace.

2.41 Texas Government Code, Chapter 2252, non-resident bidders; Texas Law prohibits Cities and Governmental units from awarding contracts to a non-resident unless the amount of such bid is lower than the lowest bid by a Texas resident by the amount a Texas resident would be required to underbid in the non-resident bidders state.

2.42 The vendor shall purchase and maintain in force insurance for operations under the contract as specified in Section IV Exhibit 1 of this document. Insurance certificates in the amounts shown and under the conditions noted shall be provided to the City before the commencement of any work.

2.43 Workers' Compensation Coverage – Statutory. See Insurance Requirements in other Sections of this document.

2.44 Attention is called to the fact that the inclusion of a minimum scale of wages to be paid to employees engaged in the work under this Contract does not release the Contractor form compliance with any State Wage Law that may be applicable. The Contractor shall abide by the Wage and Hour Laws of the State and must not pay less than the wages legally prescribed as set forth herein.

2.44.1 Except for work on legal holidays, the "general prevailing rate of per diem wage" for the various crafts or types of workmen or mechanics is the product of (a) the number of hours worked per day, except for overtime hours, times (b) the respective Rate Per Hour.

2.44.2 For legal holidays, the "general prevailing rate of per diem wage" for the various crafts or type of workmen or mechanics is the product of (a) one and one-half times the respective Rate per Hour, times (b) the number of hours worked on a legal holiday.

2.44.3 The "general prevailing rate for overtime work" for the crafts or type of workmen or mechanics is one and one-half times the above respective Rate per Hour.

2.44.4 Under the provisions of Article 5159a Vernon's Annotated Texas Statues, the Contractor shall forfeit as a penalty to the entity on whose behalf the Contract is made or awarded, Ten Dollars ($10.00) for each laborer, workman, or mechanic employed, for each calendar day or portion thereof that such laborer, workman or mechanic is paid less than the said stipulated rates for any work under the Contract, by him or by any sub-contractor under him.

2.45 Provide the names and locations of at least three (3) references at which the bidder has conducted similar services and requirements along with specific individuals whom we may contact for references.

2.46 All protests regarding the bid solicitation process must be submitted in writing to the Purchasing Manager within five (5) working days following the opening of bids. This includes all protests relating to advertising of bid notices, deadlines, bid opening, and all other related procedures under the Local Government Code, as well as any protests relating to alleged improprieties or ambiguities in the specifications. The limitation does not include protests relating to staff recommendations as to award of this bid. Protests relating to staff recommendations may be directed to the City Secretary.

2.47 Bid tabulations can be accessed in the City of Lucas website: https://www.lucastexas.us/bid-postings. Please allow at least one week after opening date for bids to be tabulated.

2.48 Prohibition of Boycott Israel. Vendor verifies that it does not Boycott Israel, and agrees that during the term of this Agreement will not Boycott Israel as that term is defined in Texas Government Code Section 808.001, as amended.

2.49 COOPERATIVE PURCHASING: As permitted under Interlocal Cooperation Act C Texas Government Code, Chapter 791, other governmental entities may wish to also participate under the same terms and conditions contained in this contract. If this bid is not specifically for the Collin County Governmental Purchaser's Forum, each entity wishing to participate must have prior authorization from the City of Lucas and the vendor. If such participation is authorized, all purchase orders will be issued directly from and shipped directly to the entity requiring supplies/services. The City of Lucas shall not be held responsible for any orders placed, deliveries made or payment for supplies/services ordered by the entities. Bidder is to state their willingness to allow other governmental entities to participate in this contract, if awarded. Vendors bidding products other than those specified should submit technical specification literature with bids.

IS YOUR FIRM WILLING TO ALLOW OTHER GOVERNMENTAL ENTITIES TO PARTICIPATE IN THIS CONTRACT, IF AWARDED, UNDER THE SAME TERMS AND CONDITIONS?

_____YES _____NO

CITY OF LUCAS (OWNER)
WEST LUCAS ROAD RECONSTRUCTION AND WIDENING

SPECIAL CONDITIONS - INDEX

SC.1 General

SC.2 Engineer

SC.3 Location of Project

SC.4 Scope of Work

SC.5 Forms, Plans & Specifications

SC.6 Time & Order of Completion

SC.7 Qualification of Bidder & Award of Contract

SC.8 Addenda

SC.9 Liquidated Damages for Delay by Contractor

SC.10 Copies of Plans & Specifications Furnished

SC.11 State & City Sales Taxes

SC.12 Referenced Specifications

SC.13 Trade Names and Materials

SC.14 Concrete & Hot Mix Asphaltic Concrete Mix Designs

SC.15 Permits and Right-of-Way

SC.16 Property Lines & Monuments

SC.17 Existing Structures

SC.18 Existing Utilities & Service Lines

SC.19 Public Utilities & Other Property to be changed

SC.20 Fences, Drainage Channels & Crop Damage

SC.21 Project Maintenance

SC.22 Cleanup

SC.23 Guarantee Against Defective Work

SC.24 Testing and Quality Control

SC.25 Coordination With Others

SC.26 Use of Explosives

SC.27 Barricades, Lights and Watchmen

SC.28 Sanitary Facilities

SC.29 Disposal of Waste & Surplus Excavation

SC.30 Inspection

SC.31 Lights & Power

SC.32 Insurance Requirements

SC.33 Construction Staking

SC.34 Superintendence by Contractor

SC.35 Connections to Existing Facilities

SC.36 Construction Schedule & Projection of Payments

SC.37 Examination of Site of Project

SC.38 Partial Payments

SC.39 Construction in Public Roads & Private Drives

SC.40 Protection of Trees

SC.41 Grass Repair

SC.42 Antitrust

SC.43 Compliance with Air & Water Acts

SC.44 Water for Construction

SC.45 Video of Project Site

SC.46 Overtime Work

SC.47 Dust Control

SC.48 Pollution Control

SC.49 Construction Data

SC.50 Pre-Construction Conference

SC.51 Shop Drawings & Engineering Data

SC.52 Special Structures

CITY OF LUCAS (OWNER)
WEST LUCAS ROAD RECONSTRUCTION AND WIDENING

SPECIAL CONDITIONS

SC.01 GENERAL

The provisions of this section of the specifications shall govern in the event of any conflict between them and the "General Conditions of Agreement."

SC.02 ENGINEER

The word "Engineer" in these specifications shall be understood as referring to BCC Engineering, LLC., 1903 Central Drive, Suite #100, Bedford, Texas 76021, Engineer of the Owner, or such other representatives as may be authorized by said Owner to act in any particular position.

SC.03 LOCATION OF PROJECT

This project is located in the City of Lucas, Collin County, Texas. A map showing the work areas is included in the plans.

SC.04 SCOPE OF WORK

The work to be performed under this contract consists of furnishing all materials, labor, tools, equipment, supervision, and all incidentals required and performing all work necessary for West Lucas Reconstruction and Widening; along with all necessary appurtenances.

SC.05 FORMS, PLANS & SPECIFICATIONS

Forms of Proposal, Contract and Bonds, and Plans and Specifications may be obtained from the xxxxxxxx., 1903 Central Drive, Suite #100, Bedford, Texas 76021.

SC.06 TIME AND ORDER OF COMPLETION

All items of work included under this contract shall be completed within the number of calendar days as bid by the contractor. Time shall commence on the tenth (10th) day after the issuance of the Notice to Proceed. The Notice to Proceed shall consist of a written request by the Owner to the Contractor to proceed with the construction of the project.

SC.07 QUALIFICATION OF BIDDER AND AWARD OF CONTRACT

It is the intention of the Owner to award a contract for the work included in this project on the basis of the lowest acceptable bid submitted by a qualified bidder, as determined by the Owner.

Prior to award of the contract, the bidder shall submit such evidence as the Owner may require to establish the bidder's qualifications to satisfactorily perform the work included in this project. Information that may be required shall include (1) the bidder's current financial statement including amount of funds readily available to commence and carry out the work, (2) a list of equipment available for this project, (3) a list of projects that have been satisfactorily completed by the bidder that are of the same general type as included in this contract, together with the names, addresses and phone numbers of persons familiar with this work, and (4) other information that may be pertinent to the bidder's qualifications.

Should the bidder fail to produce evidence satisfactory to the Owner on any of the foregoing points they may be disqualified, and the work awarded to the next bidder so qualifying.

SC.08 ADDENDA

Bidders desiring further information or interpretation of the plans and specifications must make request for such information to the Engineer by May 26, 2026. Answers to all such requests will be given in writing to all bidders in addendum form and all addenda will be bound with and made a part of the contract documents. No other explanation or interpretation will be considered official or binding. Should a bidder find discrepancies in, or omissions from the plans, specifications, or contract documents, or should they be in doubt as to their meaning, they are

requested to notify the Engineer in order that a written addendum may be sent to all bidders. Any addenda issued prior to twenty-four (24) hours before the opening of bids will be mailed or delivered to each Contractor contemplating the submission of a proposal on this work. The proposal as submitted by the Contractor will be so constructed as to include any addenda if such are issued by the Engineer prior to twenty-four (24) hours before the opening of bids.

SC.09 LIQUIDATED DAMAGES FOR DELAY BY CONTRACTOR

The Contractor understands and agrees that time is of the essence of this contract and that for each day of delay beyond the date agreed upon for the completion of all items of work herein specified and contracted for (after due allowance of such extension of time as is provided for in the General Conditions of Agreement), the Owner may withhold permanently from the Contractor's total compensation the sum of Two Thousand Dollars ($2000.00) per day as stipulated damages for such delay.

SC.10 COPIES OF PLANS AND SPECIFICATIONS FURNISHED

Five (5) sets of plans and specifications shall be furnished to the Contractor, at no charge, for construction purposes. Additional copies may be obtained at cost of reproduction upon request.

SC.11 STATE AND CITY SALES TAXES

Recent legislation has removed the sales tax exemption previously provided by Section 151.311 of the Tax Code covering tangible personal property purchased by a contractor for use in the performance of a contract for the improvement of City-owned realty.

It is still possible, however, for a contractor to make tax-free purchases of tangible personal property which will be incorporated into and become part of a City construction project through the use of a "separated contract" with the City. A "separated contract" is one which separates charges for materials from charges for labor. Under such a contract, the contractor becomes a "seller" of those materials which are incorporated into the project, such as bricks, lumber, concrete, paint, etc. The contractor issues a resale certificate in lieu of paying the sales tax at the time such items are purchased. The contractor then receives an exemption certificate from the City for those materials. (This procedure may not be used, however, for materials which do not become a part of the finished product. For example, equipment rentals, form materials, etc. are not considered as becoming "incorporated" into the project.)

Utilization of this "separated contract" approach eliminates the need for bidders to figure in sales tax for materials which are to be incorporated into the project. The successful bidder will be asked to complete a bid form separating materials and labor. The successful bidder's bid form will be used to develop the "separated contract" and will determine the extent of the tax exemption.

Non-Taxable materials are designated as such in each bid item. All other items are labor and taxable material.

SC.12 REFERENCED SPECIFICATIONS

Where reference is made in these specifications to specifications compiled by others, such reference is made for expediency and standardization from the material supplier's point of view, and such specifications referred to are hereby made a part of these specifications.

SC.13 TRADE NAMES AND MATERIALS

No material which has been used by the Contractor for any temporary purposes whatsoever is to be incorporated in the permanent structure without written consent of the Engineer.

SPECIAL CONDITIONS

Where materials or equipment are specified by a trade or brand name, it is not the intention of the Owner to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality or performance, and to establish an equal basis for the evaluation of bids. Where the words "equivalent", "proper", or "equal to" are used, they shall be understood to mean that the thing referred to shall be proper, the equivalent of, or equal to some other thing, in the opinion of judgment of the Engineer. Unless otherwise specified all materials shall be of the best of their respective kinds, shall be in all cases fully equal to approved samples and shall never have been used for any temporary purpose whatsoever. Notwithstanding that the words "or equal to" or other such expressions may be used in the specifications in connection with a material, manufactured article or process, the material, article, or process specifically designated shall be used, unless a substitute shall be approved in writing by the Engineer, and the Engineer shall have the right to require the use of such specifically designated material, article, or process.

SC.14 CONCRETE & HOT MIX ASPHALTIC CONCRETE MIX DESIGNS

The Contractor shall submit proposed concrete and hot mix asphaltic concrete (HMAC) mix designs for each class of concrete and HMAC to the Owner for review and acceptance. Concrete mix designs shall be proportioned according to the requirements of A.C.I. 318-19, and include data from field experience and/or trial mixtures with the results of confirmation cylinders. The mix designs and supporting data shall be submitted and accepted at least fourteen (14) calendar days prior to placing concrete or HMAC.

SC.15 PERMITS AND RIGHT-OF-WAY

The Owner will provide rights-of-way for the purpose of construction without cost to the Contractor by securing permits in areas of public dedication or by obtaining easements across privately owned property. It shall be the responsibility of the Contractor, prior to the initiation of construction through private property, to inform the property owner of their intent to begin construction. Before beginning construction in areas of public dedication, the Contractor shall inform the agency having jurisdiction in the area forty-eight (48) hours prior to initiation of work, unless otherwise specified herein.

SC.16 PROPERTY LINES & MONUMENTS

The Contractor shall protect all property and right-of-way corner markers, and when any such markers or monuments are in danger of being disturbed, they shall be properly referenced and if disturbed shall be reset at the expense of the Contractor.

SC.17 EXISTING STRUCTURES

The plans show the location of all known surface and subsurface structures and service lines. However, the Owner assumes no responsibility for failure to show any or all of these structures on the plans, or to show them in their exact location. It is mutually agreed that such failure shall not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as to necessitate changes in the lines or grades, or require the building of such work, provisions for which are not made in the plans and proposal, in which case the provisions in these specification for extra work shall apply.

SC.18 EXISTING UTILITIES AND SERVICE LINES

The Contractor shall be responsible for the protection of all existing utilities or service lines crossed or exposed by their construction operations. Where existing utilities or service lines are cut, broken or damaged, the Contractor shall

replace the utilities or service lines with the same type of original construction, or better, at their own cost and expense. The Contractor shall contact the utility company prior to construction near their services.

AT&T
James Dewey – 972-649-8732
jd0623@att.com

Atmos
David Stageberg – 214-733-5150
david.stageberg@atmosenergy.com

City of Lucas Water
Jeremy Bogle – 972-912-1210
jbogle@lucastexas.us

Coserv
Shawn Mead – 940-321-7800
smead@coserv.com

Frontier Communications
Carl Shipman
carl.x.shipman@ftr.com

Grayson Collin Electric Cooperative
Keith Simco
ksimco@gcec.net

North Texas Municipal Water District
Ronnie Simpkins – 469-626-4569
rsimpkins@ntmwd.com

SC.19 PUBLIC UTILITIES AND OTHER PROPERTY TO BE CHANGED

In case it is necessary to change or move the property of any owner or of a public utility, such property shall not be moved or interfered with until authorized by the utility company and approved by the Engineer. The right is reserved to the owner of public utilities to enter upon the limits of the project for the purpose of making such changes or repairs to their property that may be made necessary by the performance of this contract.

SC.20 FENCES, DRAINAGE CHANNELS AND CROP DAMAGE

Boundary fences or other improvements removed to permit this construction shall be replaced in the same location and left in a condition as good as or better than that in which they were found. No separate pay item has been established for fence removal and replacement. All work and materials required to remove and replace existing fences shall be considered subsidiary to the appropriate bid items.

Where surface drainage channels are disturbed or blocked during construction, they shall be restored to their original condition of grade and cross section after the work of construction is completed. In locations where the work site is in or adjacent to fields containing crops, the Contractor shall reimburse the Owner of said crops for all damages thereto as a result of activities of the Contractor, except crops which lie within the permanent or construction easement.

SC.21 PROJECT MAINTENANCE

The Contractor shall maintain, and keep in good repair, the improvements covered by these plans and specifications during the life of their contract.

SC.22 CLEANUP

The Contractor shall at all times keep the job site as free from all material, debris, and rubbish as is practicable and shall remove same from any portion of the job site as construction of that portion is completed. No item of work will be considered complete for payment purposes until required cleanup has been performed.

Upon completion of the work, the Contractor shall remove from the site all plant, materials, tools, and equipment belonging to him and leave the site with an acceptable appearance. The

Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver over such materials and equipment in a bright, clean, polished, and new-appearing condition.

SC.23 GUARANTEE AGAINST DEFECTIVE WORK

The Contractor shall indemnify the Owner against any repairs which may become necessary to any part of the work performed under the contract, arising from defective workmanship or materials used therein, for a period of two (2) years from the date of final acceptance of the work.

SC.24 TESTING AND QUALITY CONTROL

A. Testing Materials

Observation of the Contractor's work to determine compliance with the plans and specifications will include testing of material installed on the project. Testing of work performed and materials furnished shall be done by a certified testing laboratory employed by the Contractor. All inspection and testing laboratories must be approved by the Owner prior to performing any work. The Contractor shall use only materials in the work which meet the requirements of the specifications. The Contractor will employ the services of an Engineering Testing Laboratory to make inspections and to sample and test the materials to be used in the work. Inspection and Testing Certifications shall be submitted a minimum of two weeks prior to beginning related work. The Contractor shall furnish, at their own expense, all necessary specimens for testing of the materials and when requested, shall furnish a complete written statement of the origin, composition, and/or manufacturer of any or all materials that are to be used in the work. All materials not conforming to the requirements of the specifications will be rejected.

B. Quality Control

During the construction, the Owner may retain an Engineering Testing Laboratory to perform services related to checking the quality of the work being performed by the Contractor to determine if the improvements are being constructed in accordance with the plans and specifications. THIS QUALITY CONTROL SERVICE DOES NOT RELIEVE THE CONTRACTOR OF THEIR RESPONSIBILITY WITH REGARD TO CONSTRUCTING THE WORK IN ACCORDANCE WITH THE CONTRACT. If the Contractor fails to meet specified conditions on the first test, further tests to demonstrate compliance with the contract shall be at the expense of the Contractor. THE CONTRACTOR SHALL GIVE THE ONSITE REPRESENTATIVE OF THE OWNER SUFFICIENT NOTICE OF THEIR INTENTION TO CONSTRUCT PORTLAND CEMENT CONCRETE PAVEMENT, STRUCTURAL CONCRETE, OR HOT MIX ASPHALTIC CONCRETE TO ASSURE THE ADEQUATE QUALITY CONTROL OF CONSTRUCTION MATERIALS AND WORKMANSHIP.

C. Testing and Quality Control Services

Testing and Quality Control services shall include but are not limited to the following:

1) Reinforced Concrete Pavement

a) Analysis of Aggregates
b) Decantation Tests
c) Inspect Aggregate Stockpiles
d) Prepare or Check Concrete Batch Design
e) Slump and Air Content Tests
f) Flexural or Compressive Strength Tests

2) Lime Treated Subgrade

a) Liquid and Plastic Limits and Lime Series of Subgrade Soil
b) Lime Application Control Including Moisture Content Control Gradation and Mixing Depth
c) Moisture - Density Curve for Different

Soil Classes
d) Field Compaction Tests

3) Embankment

a) Moisture - Density Curves
b) Field Compaction Tests

4) Hot Mix Asphaltic Concrete

a) Prepare or Check Mix Design
b) Provide Full Quality Control at Hot Mix Plant

- Hot Bin Gradation Tests
- Air Void
- Stability and Density Tests
- Percent Asphalt Content

c) Make Tests from Samples of Mix

- Roll Pattern Testing
- Extraction
- Gradation
- Percent Asphalt
- Stability and Density Tests
- Make Hot Bin Analysis Every 250 Tons

5) Flexible Base

a) Sieve Analysis
b) Liquid and Plastic Limits of Binder Material
c) Moisture - Density Curves
d) Field Density Tests

6) Structural Concrete

a) Mix Design Verification
b) Batch Plant Weight & Moisture Checks
c) Temperature, Slump, Unit Weight, and Air Tests
d) Compressive Strength Tests

SC.25 COORDINATION WITH OTHERS

In the event other contractors are doing work in the same area simultaneously with this project, the Contractor shall coordinate their proposed construction with that of the other contractors.

SC.26 USE OF EXPLOSIVES

Use of explosives will not be allowed on this project.

SC.27 BARRICADES, LIGHTS & WATCHMEN

Where the work is carried on in or adjacent to any street, alley, or public place the Contractor shall, at their own cost and expense, furnish and erect such barricades, fences, lights, and danger signals, shall provide such watchmen, and shall provide such other precautionary measures for the protection of persons or property and of the work as are necessary. Barricades shall be painted in a reflective color that will be visible at night. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any work under construction. The Contractor shall furnish watchmen in sufficient numbers to protect the work.

The Contractor will be held responsible for all damage to the work due to failure of barricades, signs, lights, and watchmen to protect it and whenever evidence is found of such damage the Contractor shall immediately remove the damage portion and replace it at their cost and expense. The Contractor's responsibility for the maintenance of barricades, signs, and lights, and for providing watchmen shall not cease until the project shall have been accepted by the Owner.

SC.28 SANITARY FACILITIES

Contractor shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the project. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public

view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 workers. Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

SC.29 DISPOSAL OF WASTE & SURPLUS EXCAVATION

All trees, stumps, slashings, brush, other debris, or deleterious material generated as a part of this work, shall be burned, or removed from the property. Any required disposal permits shall be the sole responsibility of the Contractor.

All excavated earth in excess of that required for backfilling shall be removed from the job site and disposed of in a satisfactory manner except in locations where, in the judgment of the Owner, it can be neatly spread over the adjacent area.

SC.30 INSPECTION

The word "Inspection", or other forms of the word, as used in the contract documents for this project shall be understood as meaning the Owner's agent will observe the construction on behalf of the Owner. The Owner's agent will observe and check the construction in sufficient detail to satisfy himself that the work is proceeding in general accordance with the contract documents, but they will not be a guarantor of the Contractor's performance.

SC.31 LIGHTS AND POWER

The Contractor shall provide, at their own expense, temporary lighting and power facilities required for the proper prosecution of the work.

SC.32 INSURANCE REQUIREMENTS

Before the Contractor commences work in connection with this contract, or before they allow any subcontractor to commence any work, they shall purchase Comprehensive General Liability insurance in the amount of $1,000,000 with Bodily Injury limits of not less than $300,000 each occurrence and $500,000 in the aggregate, and property damage limits of not less than $100,000 each occurrence and $100,000 in the aggregate.

The Contractor shall purchase and furnish to the Owner, an Owner's and Contractor's Protective Liability policy in the amounts designated above, with the City of Lucas as insured, their agents and employees as additional insureds.

The Contractor shall furnish a Certificate of Insurance for the above coverage with a provision that the Owner will be notified by the insurance company ten (10) days prior to cancellation of the policy during the term of this contract, and if canceled a new policy must be furnished prior to cancellation. All required insurance shall remain in force through the duration of this contract.

All Subcontractors shall comply with the aforementioned conditions.

Should any person sustain bodily injury or property damage within the limits of this project, the Contractor or their Insurance Agent shall investigate immediately and report their findings in writing to the Owner. If the Contractor fails or refuses to investigate and report such occurrence upon notification of the injured or damaged party or the Owner, then the Owner shall file for coverage under the Owners' and Contractors' Protective Liability policy.

SC.33 CONSTRUCTION STAKING

The contractor shall provide construction staking at their own expense. Refer to Item 105.4 of the General Provisions of this contract (NCTCOG).

SC.34 SUPERINTENDENCE BY CONTRACTOR

The Contractor shall have on the project at all working times, as their agent, a competent Superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of work being

performed. The Superintendent shall have full authority to execute orders or directions and to promptly supply such materials, equipment, tools, labor, and incidentals as may be required. Such superintendence shall be furnished irrespective of the amount of the Work subcontracted.

SC.35 CONNECTIONS TO EXISTING FACILITIES

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock if necessary) to complete connections in the minimum time. Operations of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the Owner.

SC.36 CONSTRUCTION SCHEDULE AND PROJECTION OF PAYMENTS

Prior to starting work, the Contractor shall submit a proposed schedule for the work included herein and shall submit any major revisions to this schedule as the project progresses. This schedule shall provide for completion of the project within the time provided in the specifications.

For the duration of the project, unless otherwise approved by the Owner or the Engineer, the Contractor shall submit an up to date project schedule with each pay application, showing the Contractor's current progress and forecast. This monthly schedule shall be considered a part of the pay application, and subject to rejection.

The contractor shall also furnish 3 week lookahead schedules during each weekly progress meeting.

SC.37 EXAMINATION OF SITE OF PROJECT

Prospective bidders shall make a careful examination of the site of the project, soil, and water conditions to be encountered, improvements to be protected, disposal sites for surplus materials not designated to be salvaged materials, and as to method of providing ingress and egress to private properties, and methods of handling traffic during construction of the entire project.

SC.38 PARTIAL PAYMENTS

Item 109.5 of the General Provisions of Agreement (NCTCOG) shall be revised with the addition to the following:

On projects where the contract price, at the time of execution, is greater than $400,000, the Owner shall retain 5% of the amount due the Contractor until final payment, or the Owner may retain 10% of the amount due the Contractor until final payment with the retainage above 5% deposited in an interest-bearing account and interest earned on such 5% retained funds shall be paid to the Contractor upon completion of the contract.

SC.39 CONSTRUCTION IN PUBLIC ROADS AND PRIVATE DRIVES

No public road shall be entirely closed overnight. It shall be the responsibility of the Contractor to build and maintain all weather bypasses and detours, if necessary, and to properly light, barricade and mark all bypasses and detours that might be required on and across the roads involved in the work included in this contract.

The Contractor shall make every effort to complete construction and allow immediate access to adjacent property at driveway entrances located along the roads. Owners or tenants of improvements where access and/or entrance drives are located shall be notified at least twenty-four (24) hours prior to the time the construction will be started at their drive-ins or entrances and informed as to the length of time driveways will be closed, which period shall not exceed six (6) hours.

Materials should be available within the vicinity of this work to allow for immediate emergency access.

The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of one year from the date of such reconstruction. In the event the repairs and maintenance are not made immediately to the satisfaction of the Owner, and it becomes necessary for the Owner to make such repairs, the Contractor shall reimburse the Owner for the cost of such repairs.

The Contractor shall, at all times, keep a sufficient width of the roadway clear of dirt and other material to allow the free flow of traffic. The Contractor shall assume any and all responsibility for damage, personal or otherwise, that may be caused by the construction along roads and private drives.

SC.40 PROTECTION OF TREES

The Contractor shall make every reasonable effort to protect all trees along the project right-of-way. When crossing private property, no tree outside of the permanent right-of-way of the project, six inches (6") in diameter or larger shall be removed or have limbs trimmed without the approval of the Property Owner. Clipping or sawing of branches shall be done neatly by an approved method to prevent splitting or tearing of the wood. Pruning paint shall be applied to the newly cut branches. Minor adjustments in alignment will be allowed to protect trees.

SC.41 GRASS REPAIR

Contractor shall obtain a “Stand of Grass” for an area to be considered repaired. A “Stand of Grass” is obtained when an area to be seeded or hydromulched has at least 75% of the area covered with grass at least 1-inch high. Areas designated to be seeded or hydro-mulched shall obtain a “Stand of Grass” prior to qualifying for acceptance by the Owner and additional seed, fertilizer and water or hydro-mulch and water shall be applied until a “Stand of Grass” is obtained. No separate pay shall be made for repair of damaged grass areas, unless indicated on the plans, but such work as required shall be subsidiary to the various other items bid.

SC.42 ANTITRUST

The Contractor hereby assigns to the Owner any and all claims for overcharges associated with this contract, which arise under the antitrust laws of the United States 15 U.S.C.A. Sec. 1, et seq. (1973).

SC.43 COMPLIANCE WITH AIR AND WATER ACTS

In compliance with the Clean Air Act, as amended, 41 U.S.C. Sec. 7401 et. seq., and the regulations of the Environmental Protection Agency with respect thereto the Contractor agrees that.

A. Any facility to be utilized in the performance of this contract or any subcontract shall not be a facility listed on the EPA List of Violating Facilities pursuant to 40 CFR 15.20.

B. They will comply with all requirements of Section 114 of the Clean Air Act, as amended.

C. No work shall be performed within Muddy Creek until all proper environmental permits have been acquired by the Contractor. These may include, but are not limited to: EPA Section 404 of the Clean Water Act, TCEQ Section 401 Certification Review, TCEQ TXR150000 Stormwater Permit, etc.

D. The contractor must furnish an Emergency Evacuation Plan for work within Muddy Creek 5 working days prior to the beginning of the work.

SC.44 WATER FOR CONSTRUCTION

The Contractor shall make the necessary arrangements for securing and transporting water for construction, including water for testing,

mixing of concrete, sprinkling, flushing, flooding, or jetting.

The Contractor can coordinate with the City to receive a temporary water meter. A deposit of $1,500.00 will be required for use of the meter.

Any party requesting use of a temporary water meter, to be attached to a City of Lucas fire hydrant for the purpose of receiving water for construction, shall use the meter in a proper manner and maintain the meter in working condition.

Such meter shall be attached to fire hydrants only when water is being discharged from the hydrant. It is unlawful for any party to leave a temporary fire hydrant water meter connected to a fire hydrant at any time when water is not being discharged from said hydrant.

Temporary fire hydrant water meters will be read on a monthly basis by a representative of the Lucas Utility Meter Department. Water volume used will be reported to, and monitored by, the City Inspector.

SC.45 VIDEO OF PROJECT SITE

The Contractor shall provide the City a video recording of the entire project site prior to commencement of construction activities. The contractor shall provide a second video recording to the City of the entire project site once construction is complete and prior to final testing and acceptance by the City. There is no additional pay item for the video recordings, and they are considered subsidiary to the project.

SC.46 OVERTIME WORK

No work shall be scheduled between 7:00 p.m. and 7:00 a.m. or on Saturdays, Sundays, or legal City holidays without permission of Owner. Should Contractor desire to work on these days, they shall contact the Owner, in writing, for approval at least 48 hours in advance. However, emergency work may be done without prior permission. Tie-ins and connections to existing facilities will be made at time authorized by the Owner.

SC.47 DUST CONTROL

Contractor shall take responsible measures to prevent unnecessary dust. Earth surfaces subject to creating dust shall be kept moist with water or by application of a chemical dust suppressant. Dusty materials in piles or in transit shall be covered when practical to prevent blowing. Machinery, motors, instrument panels, or similar equipment, shall be protected by suitable dust screens with proper ventilation included.

SC.48 POLLUTION CONTROL

Contractor shall prevent the release of sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris or other substance will be permitted to enter sanitary sewers and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

SC.49 CONSTRUCTION DATA

The Contractor shall keep one record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show all changes made during the construction process. These shall be available to Owner and shall be delivered to the Owner upon completion of the work.

SC.50 PRE-CONSTRUCTION CONFERENCE

Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

- Contractor and their superintendent
- Principal Subcontractors together with Principal suppliers and manufacturers' representatives
- Representatives of Owner
- Materials Testing Laboratory
- Others as requested by Contractor or Owner

Unless previously submitted to Owner, Contractor shall bring to the conference a tentative schedule for each of the following:

- Progress Schedule
- Cash Flow
- Shop Drawings and other submittals

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

- Contractor's tentative schedules
- Transmittal, review, and distribution of Contractor's submittals
- Processing applications for payment
- Maintaining record documents
- Critical work sequencing
- Field decisions and Change Orders
- Use of premises, office and storage areas, security, housekeeping, and Owner's needs
- Major equipment deliveries and priorities
- Materials testing

The Owner will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

SC.51 SHOP DRAWINGS & ENGINEERING DATA

Engineering data covering all equipment and fabricated materials to be furnished under this contract that shall be submitted to Engineer for review and permanently incorporated to the project. This data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. Concrete mix designs shall be submitted for review.

All submittals regardless of origin, shall be stamped with the approval of Contractor and identified with the name and number of this contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor's stamp of approval is a representation to Owner and Engineer that Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that they have reviewed or coordinated each submittal with requirements of the work and Contract Documents.

All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be required as a result of the deviation) and all required piping and wiring diagrams.

Contractor shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions

previously noted by Engineer are accounted for. An electronic copy of each Drawing and necessary data in Adobe Acrobat (.pdf) format, in legible color copies or color scans from original shall be submitted electronically to Engineer. Engineer will not accept submittals from anyone but Contractor.

When the drawings and data are returned marked REJECTED or REVISE AND RESUBMIT, the corrections shall be made as noted thereon and as instructed by Engineer and resubmitted.

When corrected copies are resubmitted, Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by Engineer on previous submissions.

It will be Contractor's responsibility to schedule the submission of submittals so as not to impede the scheduled construction activities or affect the completion date.

Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time unless delay of the work is directly caused by a change in the work authorized by a Change Order or by failure of Engineer to return any submittal within 30-days after its receipt in Engineer's office.

The Engineer's review of drawings and data submitted by Contractor will cover general conformity to the Drawings and Specifications, external connections and dimensions that affect the layout. Engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or items shown. Engineer's review of submittals shall not relieve Contractor from responsibility for errors, omissions, or deviations, or responsibility for compliance with the Contract Documents.

SC.52 Special Structures

The 10' x 8' Junction Box may not be available as a precast structure. The Contractor should be aware of its availability prior to bidding this item as precast, or cast in place. After the contract is executed, any change to the construction of the structure will be considered the Contractor's means and methods, and shall be at no additional cost to the City.

SPECIAL SPECIFICATIONS

501.21. SOLID WALL POLYETHYLENE PLASTIC PIPE FOR WATER, WASTEWATER, AND PIPE REHABILITATION

501.21.1. General. Pipe and fittings shall conform to the material and physical properties as described in ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, unless otherwise specified herein or in the special specifications. Standard Lengths shall be 40-ft or 50-ft for straight pipe. Coiled pipe may be obtained in reels of 500-ft, 1000-ft or 1500-ft depending on outside diameter and Dimension Ratio (DR) requested.

Solid wall high density polyethylene pipe (HDPE) for pressure water pipe shall meet the requirements of AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ in. Through 3 In., for Water Service or AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In., for Water Distribution.

501.21.2. Material. Pipe and fittings shall be made of high density, high molecular weight polyethylene pipe PE3408 material, polyethylene resin which conforms to Polyethylene Plastics Molding and Extrusion Materials, meeting the requirements of Type III, Grade P33, as defined in ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials. The polyethylene plastic shall meet the Cell Classification requirements of 345464C or 345464E as defined in ASTM D3350. Pipe for non-pressure applications shall have a light colored interior for video inspection, unless otherwise specified in the plans, contract documents or purchase request.

501.21.3. Dimensions. The polyethylene (PE) pipe shall meet the dimension ratios and outside diameter, wall thickness and tolerances as provided in the reference specifications of manufacture as listed in Table 501.21.3.(a) Solid Wall PE Pipe Dimension Standards. Diameters and wall thickness other than those shown in the standards may be used if specifically called for in the plans, contract documents or purchase request, and if they are mutually agreed upon by the manufacturer and OWNER.

Table 501.21.3.(a) Solid Wall PE Pipe Dimension Standards.

Standard	Topic
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, ½ in Through 3 in for Water Service
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4in through 63in for Water Distribution and Transmission
ASTM D2239	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D2737	Polyethylene (PE) Plastic Tubing
ASTM D3035	Polyethylene (PE) Plastic Pipe Based on Controlled Outside Diameter
ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

501.21.4. Joints. Dependent upon installation requirements, site location, weather conditions, and the presence of water, joining shall be performed within or outside the excavation. Sections of polyethylene pipe and fittings shall be joined by the butt fusion process, unless an alternate method is approved by the OWNER. The butt (heat) fusion method shall be performed in accordance with the pipe manufacturer's recommendations. Electrofusion fittings shall be used. Extrusion welding or hot gas welding of PE shall not be used for pressure pipe application or fabrications where shear or structural strength is important.

501.21.5. Tests and Requirements. Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM or AWWA Standard(s). All polyethylene pipe shall be tested for brittleness, joint separation, quality, and ring stiffness as specified in the applicable ASTM or AWWA Standard(s). A certification of compliance with this specification shall be furnished by the manufacturer for all material furnished under this specification. In addition, the OWNER may, at its own expense, witness inspection and test of the materials.

501.21.5.1. Tensile Properties. The tensile strength, yield strength, elongation and elastic modulus of the material shall be determined in accordance with Tensile Properties for Plastics, ASTM D638 (D638M).

501.21.5.2. Hydrostatic Properties. The long term hydrostatic strength rating shall be listed in the name of the pipe and fittings manufacturer in PPI (Plastic Pipe Institute) TR-4,

Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings compounds, with a standard grade HDB rating of 1600-psi at 73°F.

501.21.5.3. Melt Index. The melt index of the polyethylene plastic, as determined in accordance with ASTM D1238 Flow Rates of Thermoplastics by Extrusion Plastometer, shall meet the requirements as specified in ASTM D3350 Cell Classification of 4.

501.21.5.4. Density. The density of the polyethylene plastic, as determined in accordance with ASTM D1505 Density of Plastics by the Density - Gradient Technique shall have specific base resin densities meeting the requirements as specified in ASTM D3350 Cell Classification 3.

501.21.5.5. Environmental Stress Cracking Resistance. The environmental stress cracking resistance (ESCR) of the material shall meet the requirements as specified in ASTM D3350 Cell Classification of 6 using ASTM F1473 (PENT) or meet a Cell Classification of 4 according to ASTM D1693.

501.21.5.6. Wastewater Pipe Stiffness. Minimum pipe stiffness at five-percent deflection shall be 46-psi for all sizes of gravity and pressure wastewater conduits as specified in Section XI “Deflection Control In Unpressurized Polyethylene Piping Systems,” Table X1.1 “Pipe Stiffness Ranges for Specified Materials” and DR's of ASTM F714.

Special Specification 7095
Water Line Installation

1. DESCRIPTION

Water mains including valves, valve boxes, service meters, hydrants, blocking, fittings, and other appurtenances for potable water distribution systems. Steel and Iron materials must comply with 23 CFR 635.410 provisions of Buy America.

1.1. **References.** When referring to the standards listed below, it means the latest standard or tentative standard in effect on the date of the proposal.

- ANSI 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- 30 TAC 290 - Texas Administrative Code, Volume 30, Chapter 290, Water Hygiene.
- UL 246 - Hydrants for Fire-Protection Service.
- ASTM A53 - Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.
- ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- ASTM A307 - Specification for Carbon Steel bolts and Studs 60,000psi Tensile.
- ASTM A536 - Ductile Iron Castings
- ASTM D1784 - Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- ASTM D2737 - Polyethylene (PE) Plastic Tubing.
- ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fitting for Water.
- AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other Liquids
- AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches for Water and other Liquids.
- AWWA C150 - Thickness Design of Ductile Iron Pipe.
- AWWA C151 - Ductile Iron Pipe.
- AWWA C153 - Ductile Iron Compact Fittings, 3 inches through 12 inches for Water and other Liquids.
- AWWA C500 - Metal-Seated Gate Valves for Water Systems.
- AWWA C502 - Dry Barrel Fire Hydrants
- AWWA C509 - Resilient-Seated Gate Valves for Water Systems.
- AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- AWWA C700 - Cold Water Meters Displacement-Type, Bronze Main Case.
- AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches, for Water.
- AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing and Fittings, ½ inch through 3 inches for Water.
- AWWA C905 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 inches through 36 inches.
- ASTM C33 – Coarse Aggregates.
- ASTM D698 – Moisture-Density Relations of Soil (Standard).

- ASTM D1557 – Test for Moisture-Density Relations of Soil (Modified).
- ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity – Flow Applications.
- ASTM D2487 – Classification of Soils for Engineering Purposes.
- ASTM D4254 – Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density.
- ASTM D4318 – Test for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- OSHA – Occupational Safety and Health Administration and Related Regulations.
- AWWA B300 – Standard for Hypochlorite's.
- AWWA B301 – Standard for Liquid Chlorine.
- AWWA C651 – Standard for Disinfecting Water Mains.
- 30 TAC 290.38 through 290.49 – Rules and Regulation for Public Water Systems, *Texas Administrative Code*.

1.2. **Submittals.** Submit the following documentation in accordance with the pertinent Specification Items.

- Product Data: Manufacturer's product data sheets on all materials incorporated into Work.
- Certificates: Manufacturers certificates attesting compliance with applicable Specifications for grades, types, classes, and other listed properties.
- Project Record Documents: Submit documentation in accordance with pertinent Specification Items. Accurate record drawings showing installed locations of manholes, cleanouts, valves, piping, service connections, and other accessories.

1.2.1. **Bedding and Backfill.** Submit sample(s) of material(s) proposed to be used for bedding in the pipe zone and backfill of fiberglass structures.

- One (1) set to materials testing lab for classification.
- One (1) set to Engineer for approval.

1.2.2. **Water Line Disinfection & Testing**

- **Test Reports.** Indicate results comparative to specified requirements.
- **Certificate.** Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- **Project Record Documents.** Submit the following required documentation in accordance with the applicable Specification sections.
    - **Disinfection Report.** Information to be recorded includes: type and form of disinfectant used, date and time of disinfectant injection start and time of completion, test locations, initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested, date and time of flushing start and completion, and disinfectant residual after flushing in ppm for each outlet tested.
    - **Bacteriological Report.** Information to be recorded includes: date issued, project name and testing laboratory name, address and telephone number, time and date of water sample collection, name of person collecting samples, test locations, initial and 24-hour disinfectant residuals in ppm for each outlet tested, coliform bacteria test results for each outlet tested, certification that water conforms, or fails to conform to bacterial standards of AWWA C651, C652, and 30 TAC 290.38 through 290.46

1.3. **Delivery, Storage and Handling.** Each load of pipe delivered to the project site may be inspected by the Engineer for compliance with the Project Specifications. Pipe shall be transported with ends covered to prevent debris accumulation during transport. Pipe shall be kept in bundles (as shipped from the plant) until the day that it is to be installed. Deflection test may be required if deflection is apparent.

1.3.1. **Protection and/or Removal of Existing Utilities.** The Contractor shall anticipate all underground obstructions, such as but not limited to, water mains, gas lines, storm and sanitary sewers, telephone or electric light or power ducts, concrete and debris. Any such lines or obstructions indicated on the Drawings

show only the approximate locations and shall be verified in the field by the Contractor. The Owner and Engineer will endeavor to familiarize the Contractor with all known utilities and obstructions, but this shall not relieve the Contractor from full responsibility in anticipating all underground obstructions whether or not shown on the Drawings. The Contractor shall, at his own expense, maintain in proper working order and without interruption of service all existing utilities and services which may be encountered in the work. With the consent of the Engineer and utility owner such service connections may be temporarily interrupted to permit the Contractor to remove designated lines or to make temporary changes in the locations of services. The cost of making any temporary changes shall be at the Contractor's expense. Notify all utility companies involved to have their utilities located and marked in the field. All underground utilities in a particular segment of the project shall then be uncovered to verify location and elevation before construction begins in that segment of the project. Any utilities found, not on drawings, shall be documented and submitted with as-built drawings at project closeout.

1.4. **Definitions.** All excavation associated with the project is unclassified.

- **Bedding.** Includes the area from the trench bottom to the bottom of the pipe where material is placed to bring the trench bottom up to grade. A compacted depth of approximately 4 to 6 inches is generally sufficient bedding thickness.
- **Haunching.** Includes the area from the bottom of the pipe to the spring line of the pipe. Material in this area must be placed and consolidated to provide adequate side support while avoiding both vertical and lateral displacement of the pipe. **The type and density of the material in this area are the most important factors affecting the performance and deflection of the pipe.**
- **Initial Backfill.** Includes the area from the spring line of the pipe to a point at least 6 inches over the top of the pipe.
- **Final Backfill.** Includes the area above the initial backfill, up to final grade or the bottom of the flexible base material in the pavement section.
- **Pipe Zone.** Includes areas of bedding, haunching and initial backfill as defined above.

2. MATERIALS

Projects constructed on or after January 4, 2014 must comply with changes to the Safe Drinking Water Act that reduce the maximum allowable lead content of pipes, pipe fittings, plumbing fittings, and fixtures to 0.25 percent. Polyvinyl Chloride (PVC) pipe and fittings.

2.1. **Pipe.** PVC water pipe shall bear NSF 61 seal of approval.

Pressure Class: AWWA C900. DR 18 – Pressure Class 150. Joints shall be integral bell with flexible elastomeric seal.

Meter service line: Polyethylene pressure pipe per AWWA C901 (ASTM D2737). SDR-9, PE2306, or PE3306. Provide stainless steel stiffeners at connections.

2.2. **Fittings.** Fittings shall be push-on, mechanical joint, or flanged pipe as shown.

Ductile Iron, AWWA C110 (non-compact) or AWWA C153 (compact).

Cement lined interior, AWWA C104.

Exterior shall be bituminous coated.

Wrap buried fittings with 8-inch polyethylene encasement, AWWA C105.

Working pressure rated to 350 psi.

2.3. **Couplings.** Flanged Coupling Adapters shall conform to ASTM A126, Class B, Cast Iron. Dresser Style 127, Uni-flange Series 400, or engineer approved equal.

Flexible Couplings shall be gasketed, sleeve type, straight cast. Dresser Style 38 or Style 162, or engineering approved equal. Supply couplings with working pressures which meet or exceed the joining pipe rating.

Retainer Gland Mechanical joint fittings to PVC shall be Ductile Iron, ASTM A536, Grade 65-45-12. Uni-flange Series 1300, or engineer approved equal.

Retainer Gland Mechanical joint fittings to Ductile Iron shall be Ductile Iron, ASTM A536, Grade 60-10-10. EBBA Iron Series 100, or engineer approved equal.

Service clamps for copper tubing sizing (CTS) polyethylene pipe service connections shall be bronze, two-piece with O-Ring seal. Muller or engineer approved equal.

2.4. **Bolts and Gaskets.** Bolts shall be 1/16-inch cloth insert, red rubber, full face. Bolts shall be in accordance with Non-pressure applications (ASTM A307A), Pressure applications (ASTM A307B), and Submerged/splashed (316 stainless steel).

2.5. **Tapping Sleeves.** Shall be certified to ANSI/NSF 61.

Shell and lugs shall be 304 Stainless steel.

Bolts, washers, and nuts shall be NC Rolled Thread, 304 Stainless Steel.

Gaskets shall be Virgin SBR compounded for water service.

Outlet flange shall be 304 Stainless Steel or Ductile Iron, ASTM 536 and meet or exceed all applicable requirements of ANSI B16.1, Class 125.

2.6. **Gate Valves.** Gate Valves sizes 4-inch through 48-inch shall be solid wedge, resilient seat type.

Conform to AWWA C509.

Working pressure rated to 200 psi minimum.

Shall have a non-rising stem with O-ring valve packing and 2-inch square nut, except as shown otherwise.

Shall have mechanical joints and counter-clockwise opening.

Ferrous surfaces of valve interior epoxy coated, AWWA C550.

Wrap valve body with 8-mil polyethylene encasement in a manner which will not interfere with valve operations, buried service.

2.7. **Fire Hydrants.** Shall be standard dry barrel, AWWA C502, UL 246.

Extensions shall be fabricated in multiples of 6-inches with rod and coupling to increase barrel length.

Hose and Steamer Connections shall match sizes with utility company/municipality, two hose nozzles, one pumper nozzle.

Shall be finished with primer and two coats of enamel, color required by utility company/municipality.

2.8. **Corporation Stops.** Waterworks iron pipe size (IPS) inlet and Compression connection for CTS PE plastic pipe with rigid liner for outlet. Mueller 110 Compression or engineer approved equal.

2.9. **Meter Stops.** Compression connection for CTS PE plastic pipe with rigid liner for inlet and meter saddle nut, lock wing for outlet. Mueller 110 Compression or engineer approved equal.

2.10. **Pipe Zone.** Materials for use within the pipe zone and within 24 inches of fiberglass structures shall be in accordance with following Table 2.1:

TABLE 2.1
DESCRIPTION OF MATERIAL CLASSIFICATION
(as defined in ASTM D2321)

Class	Type	Soil Group Symbol	Description ASTM D2487	% Passing Sieve Sizes			Atterberg Limits		Coefficients	
				1½ in (40 mm)	#4 (4.75 mm)	#200 (0.075 mm)	LL[b]	PI[c]	Uniformity C_u	Curvature C_c
I	Manufactured, Processed Aggregate; dense-graded, clean	None	Angular, granular, crushed stone or rock, crushed gravel, and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines	100%	≤50%0	<5%	Non Plastic			
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines	100%	<50% of Coarse Fraction	<5%	Non-Plastic		>4	1 to 3
		GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines						<4	<1 or >3
		SW	Well-graded sands and gravelly sands; little or no fines		>50% of Coarse Fraction				>6	1 to 3
		SP	Poorly-graded sands and gravelly sands; little or no fines						<6	<1 or >3
	Coarse-Grained Soils, borderline clean to w/fines	e.g. GW-GC, SP-SM.	Sands and gravels which are borderline between clean and with fines	100%	Varies	5% to 12%			Same as for GW, GP, SW and SP	
III	Coarse-Grained Soils with Fines	GM	Silty gravels, gravel-sand-silt mixtures	100%	<50% of Coarse Fraction	>12% to <50%		<4 or <"A" Line		
		GC	Clayey gravels, gravel-sand-clay mixtures					<7 and >"A" Line		
		SM	Silty sands, sand-silt mixtures	>50% of Coarse Fraction				>4 or <"A" Line		
		SC	Clayey sands, sand-clay mixtures					>7 and >"A" Line		

[a] Includes Test Method ASTM D2487 borderline classifications and dual symbols depending on plasticity and liquid limits.
[b] LL = Liquid Limit.
[c] PI = Plasticity Index.

In addition to the materials included in Table 2.1, the following materials are approved for the pipe zone or within 24 inches of fiberglass structures where shown:

- Lean Concrete: Free-flowing grout, mixed one (1) sack of cement per cubic yard of sand.
- Structural Concrete: Concrete for encasement shall be 3000 psi compressive strength as specified in Section 03300.

2.11. **Final Backfill Materials**

Earth Backfill. Earth backfill may be excavated and reused from trench or obtained from an approved borrow area. Material shall be processed to ensure that only select material is used for backfilling operations. Material shall be free of lumps, clods, large rocks, debris, trash, organic, spongy or otherwise objectionable material. The presence of such material in the backfill may preclude uniform compaction and result in excessive localized point loads on or deflections in the piping system or fiberglass structure.

All materials included in Table 2.1 above are approved for final backfill.

2.12. **Water Quality Assurance.** Perform work in accordance with AWWA C651 and C652.

2.13. **Testing Firm**. Approved laboratory by the Texas Department of Health Bureau of Laboratories.

Submit bacteriologist's signature and authority associated with testing.

Bacteriologist test shall indicate negative. If other than negative disinfection, shall be repeated at contractor's expense.

3. CONSTRUCTION

3.1. **Preparation**. Stake locations of fittings, valves (where applicable) and other accessories prior to installation for Engineer to review.

Prior to installation, remove foreign matter from within pipes, manholes, cleanouts, fittings, and valves. Verify material is in satisfactory condition and the valves and other mechanical devices function properly.

Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to the top of pipe. When work is not in progress, close end of pipe and fittings securely so that no trench water, earth or other substances will enter pipes or fittings.

Keep inside of pipe free from foreign matter during operations by plugging or other approved method.

Place pipe so that full length of each section rests solidly upon pipe bedding, with recesses excavated to accommodate bells and joints. Take up and re-lay pipe when grade or joint is disturbed after placing.

Handle pipe and accessories so that pipe placed in trench is sound and undamaged. Take particular care not to injure pipe coating when applicable.

Cut pipe neatly, using approved type mechanical cutter without damaging pipe. Use when cutters when practicable.

Wrap ductile iron pipe fittings, and valves with 8 mil polyethylene film, AWWA C105, with edges overlapped and securely taped with duct tape to prevent contact between pipe and surrounding bedding. Repair punctures with duct tape to restore the protective continuous wrap before backfilling.

3.2. **Bedding and Backfill.** Accurately grade the bottom of the trench 4 inches below the bottom of the pipe and to the limits of the clear space on either side of the pipe.

Install materials which comply with Table 2.1 above accordance with "Pipe Bedding Detail" shown on the Drawing.

The initial layer of embedment material placed to receive the pipe shall be brought up to a grade slightly higher than that required for the bottom of the pipe and the pipe shall be placed thereon and brought to grade by tamping, or by removal of the slight excess amount of embedment under the pipe.

Adjustment to grade line shall be made by scraping away or filling with embedment materials. Wedging or blocking up of pipe will not be permitted.

Each pipe section shall have a uniform bearing on the embedment for the full length of the pipe, except immediately at the joint.

After each pipe has been graded, aligned, placed in final position on the bedding material and joint made, sufficient embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Sheeting and shoring will not be allowed in the pipe zone during or after installation of the pipe or embedment material, unless special provisions are made to ensure the specified compaction of bedding and pipe alignment is maintained after removal of sheeting and shoring.

Minimum compaction effort within the pipe zone shall be in accordance with the following Table 3.1 based on the class of bedding material used:

TABLE 3.1

MINIMUM REQUIRED COMPACTION
FOR MATERIAL USED WITHIN PIPE ZONE OR FOR BACKFILL OF FIBERGLASS STRUCTURES

Classification of Bedding Material	Standard Proctor Density[a] (Relative Density[b] shown in parentheses)
Class I	Dumped
Class II	≥85% standard (≥40% relative)
Class III	≥90% standard (≥55% relative)
Class IV	Not approved for bedding material
Class V	Not approved for bedding material

[a] Standard Proctor Density per ASTM D698, moisture content shall be ± 2% of optimum.
[b] Relative Density per ASTM D4254.

3.3. **Utility Installation.** Water Lines and Sanitary Sewers: Limit clear on either side of the pipe to 12 inches. Above the pipe, cut as wide as necessary to sheet and brace and properly perform the work. Provide class of bedding as shown. Install piping and appurtenances as specified.

Excavation for Appurtenances: Excavate sufficiently for valves, fittings, manholes, valve vaults, utility pull boxes and similar structures to leave at least 18 inches clear between the outer surfaces and the embankment or shoring that may be used to hold and protect the embankment wall. Install valves, fittings, manholes or valve vault structure, piping and appurtenances as specified. Any other-depth excavation will be refilled with lean concrete or other suitable compacted material approved by the Engineer, at no additional cost to the Owner.

3.4. **Final Backfill.** Criteria: Backfill trenches to ground surface with material as specified. Reopen trenches improperly backfilled to depth required for proper compaction. Refill and compact as specified, or otherwise correct the condition in an approved manner.

Take care to avoid contacting pipe or structure to be backfilled with compaction equipment. Do not use compaction equipment directly over the pipe until sufficient initial backfill has been placed to assure such equipment will not be damage or disturb the pipe.

All forms, lumber, trash and debris shall be removed from trenches, manholes and other utility structures prior to backfilling.

Dispose of unacceptable backfill material and provide suitable material for backfill at no additional cost to the Owner.

3.4.1. **Open Areas.** Above the pipe zone, deposit earth backfill from excavated material, compact to minimum of 85 percent of maximum density per ASTM D698, while maintaining moisture within ± 2 percent of optimum. Excavated material placed shall be free of rock greater than two (2) inches in any direction.

Backfill for valves, fittings, manholes, utility pull boxes and other utility structures shall be placed in accordance with applicable Specification Sections.

3.4.2. **Pavement Section.** Above the pipe zone to below the flexible base material, deposit earth backfill from excavated material, compact to minimum of 95 percent of maximum density per ASTM D698, while maintaining moisture within ± 2 percent of optimum; or deposit ASTM D2487 Class II material in 6-inch lifts, compact to 40 percent relative density according to ASTM D4254.

For valves, fittings, manholes, valve vaults or boxes in pavement sections, backfill with Class II material to bottom of proposed pavement. Backfill material shall be deposited in 6-inch lifts. Class II material must be compacted to 40 percent relative density according to ASTM D4254.

3.5. **Disposal of Excess Material.** Remove waste and excess excavated material from the construction site before final inspection. Legally dispose of material:

- At a licensed and approved site.
- On adjacent private property with written and notarized permission from the property owner.
- On Owner property with written and notarized permission from the Owner.
- All cost associated with waste material removal and disposal shall be paid for by the Contractor.

3.6. **Placing and Laying.** Bury water lines as shown.

Do not exceed 75 percent of pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, use fittings.

Intersecting lines shall be joined by an appropriate fitting.

Maintain separation of water line from sewer line in accordance with 30 TAC 290.

Any adjustment to obtain correct line shall be made by tamping or removing soil and in no case by wedging or blocking pipe.

3.7. **Joints.** Install mechanical and flanged joints in accordance with manufacturer's recommendations.

Make push-on joints in accordance with manufacturer's recommendations. Lay spigot ends downstream and push-on to full depth.

3.8. **Anchorage of Fittings – Thrust Block.** Anchor tees, bends and plugged, valved or capped ends of lines of water mains with Class B concrete thrust blocks as necessary and as shown. Place blocks so that the joints will be accessible for inspection and repair.

3.9. **Install New Fire Hydrants.** Set hydrants plumb and locate pumper nozzle perpendicular to and facing the roadway. Set hydrants to grade, with nozzles at least 20 inches above ground**.** Locate control valve 6 feet away from hydrant unless otherwise shown. Provide Class B concrete thrust blocks as shown.

3.10. **Service Connections.** Service connections shall be installed at each house, building, or other locations as shown.

The Contractor shall verify the actual location of each service connection and shall confirm the location with

the Engineer.

When the service line is to be terminated at the property line, the Engineer shall determine the point of termination.

Provide water service lines and include corporation and meter stops, meters, service pressure reducing valves, and meter box installed as shown.

Make service connections in accordance with the manufacturer's recommendations.

Connections shall be located no closer than one foot from fitting or pipe joint.

Set top of meter box flush with ground.

3.11. **Disinfection.** Disinfect completed water lines with chlorine in accordance with the pertinent Items of the Specifications. Open and close valves in lines being sterilized several times during contact period.

3.12. **Testing.** The following described testing will be required for all new water lines. Upon completion of the required testing, Contractor shall provide a signed and notarized affidavit certifying that the system has been tested and meets the applicable requirements.

3.13. **Hydrostatic Tests.** Pressure test completed water lines hydrostatically. Provide pumps, gauges, meters, and other equipment necessary for performance of tests.

Pressure at the lowest point in the test section shall be at least 100 percent, but not more than 120 percent of the pressure rating of the pipe.

Minimum pressure at the highest point in the test section shall not be less than 85 percent of the pipe's pressure rating.

Leakage shall not exceed 10 gallons per inch or pipe diameter per mile of pipe per 24 hours.

Minimum test duration shall be 4 hours.

Maintain records of date tests were performed, names of people in attendance, location of test section, brand name of pipe and pressure rating.

Failed test sections shall be repaired and retested at the Contractor's expense.

3.14. **Bacteriological Tests.** After disinfection and flushing mains, obtain representative samples and conduct bacteriological tests. Test in accordance with recognized AWWA standards.

3.15. **Examination and Preparation.** Examine utility routes and coordinate excavation work to eliminate installation conflicts.

Allow room for stockpiling excavated material and utility construction material during utility construction.

3.16. Trench Excavation.

3.16.1. **Procedure**. Trenches shall be excavated to indicated or specified depths by open cut method.

Dispose of unacceptable backfill material and provide suitable material for backfill without additional expense.

During excavation, stockpile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides, or cave-ins.

Grade as necessary to prevent surface water from flowing into trenches or other excavations.

Cut walls of trench as close to vertical as the stability of the material and trench safety will allow. Remove stones as necessary to avoid point-bearing. Over-excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe. Over excavation shall be filled and tamped with clean dry sand, pea gravel, or other approved material to the required grade.

Excavate the trench the proper width as shown, or as required by the Contractor's Trench Safety Program. If the trench width below the top of pipe is wider than specified in this section or shown, install additional backfill. No additional payment will be made for additional material or work required for installation.

Accurately grade the trench bottom to provide proper bedding as required for pipe installation.

If any excavation is carried beyond the lines and grades required or authorized, the Contractor shall, at his own expense, fill such space with suitable material and properly compact the material as directed by the Engineer. No additional payment will be made.

3.16.2. **Sheeting and Bracing.** If trench safety methods do not include sloping of trench walls, install sheeting and bracing; or use appropriate trench box necessary to support the sides of trenches and other excavations with vertical sides, as required by current OSHA regulations.

3.16.3. **Water in Excavation.** Keep work free from ground or surface water at all times. Provide pumps of adequate capacity or other approved method to remove water from the excavation in such a manner that it will not interfere with the progress of the work or the proper placing of other work.

3.16.4. **Trenching Progress.** Trenching operations for any individual utility work crew shall not be in excess of 100 feet ahead of pipe laying operations in city streets or 2,000 feet in open country. Not more than two (2) consecutive cross-streets may be closed to traffic by any individual utility work crew at any given time. Ensure no trenches are left open when work is not in progress. Temporarily backfill any open trenches with un-compacted material and install proper barricades at the end of each work day.

3.16.5. **Existing Lawns and Shrubbery.** The Contractor shall take particular care to preserve existing lawns and shrubbery. Make minor pipe alignment as may be necessary.

3.16.6. **Existing Pavement.** Existing pavement over trenches shall be removed to a width of 6 inches outside of the trench on each side. Remove to a neat line by sawing method. Take appropriate measures to prevent damage to existing pavement adjacent to the trench by wheels, tracks and/or stabilizers of excavating equipment. Remove brick pavement by hand, deliver and stack as directed by the Owner.

3.16.7. **Temporary Pavement.** Place a temporary pavement over an open-cut trench pavement section within the confines of an existing roadway pavement suction including, but not limited to, asphalt (cold mix) and unimproved streets and roadways.

Place and compact 6" of flexible base course under temporary pavement sections within roadways as shown on the drawings. Apply 2" Type D Cold Mix on top of flexible base course.

Pavement replacement will be paid for by the linear foot, which shall be total payment for tamping the backfill, placing and compacting the base material, finishing and replacing the pavement as per the section.

3.17. **Disinfection/Testing Procedure.** The examination, execution and quality control shall be as follows.

3.17.1. **Examination.** Verify that piping system and structures have been cleaned, inspected, and pressure tested. Perform scheduling and disinfecting activities with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.17.2. **Execution.** Provide and attach equipment required to perform the work of this section. Inject disinfectant into piping system, tank, or structure while filling. Disinfection agent may be introduced with permanent

chlorination equipment when possible, or other means of application. Application of chlorine gas under pressure directly to the water is not permitted. Maintain disinfectant in system for 24 hours. Flush circulate and clean until required cleanliness is achieved; use municipal domestic water. Replace permanent system devices removed for disinfection.

3.17.3. **Field Quality Control**. New water mains shall be thoroughly disinfected, then flushed and sampled before being placed into service. Samples shall be collected for microbiological analysis to check the effectiveness of the disinfection procedure, which shall be repeated if contamination persists. A minimum of one sample for each 1,000 feet of completed water line is required, or the next available sampling joint beyond 1,000 feet as designated by the Engineer.

4. MEASUREMENT

- ABANDON EXIST WATER LINE / PRESSURE GROUT (2”-12”) – LF
- CUT AND PLUG EXIST WATER LINE (2”-12”) – EA
- REMOVE EXIST WATER LINE (2”12”) – LF
- CONNECT PROP 12” WATER LINE TO EXIST 4” WATER LINE – EA
- CONNECT PROP 12” WATER LINE TO EXIST 6” WATER LINE – EA
- CONNECT PROP 12” WATER LINE TO EXIST 12” WATER LINE – EA
- CONNECT PROP 6” WATER LINE TO EXIST 4” WATER LINE – EA
- CONNECT PROP 6” WATER LINE TO EXIST 6” WATER LINE – EA
- CONNECT PROP 8” WATER LINE TO EXIST 8” WATER LINE – EA
- 4” GATE VALVE – EA
- 6” GATE VALVE – EA
- 8” GATE VALVE – EA
- 12” GATE VALVE – EA
- 6” DR-18 C900 PVC WATER LINE – LF
- 8” DR-18 C900 PVC WATER LINE – LF
- 10” DR-18 C900 PVC WATER LINE – LF
- 12” DR-18 C900 PVC WATER LINE – LF
- ENCASEMENT FOR 6” WATER LINE (BORE OR OPEN-CUT) – LF
- ENCASEMENT FOR 8” WATER LINE (BORE OR OPEN-CUT) – LF
- WATER SERVICE RECONNECTS – EA
- INSTALL NEW FIRE HYDRANT – EA
- REMOVE EXIST FIRE HYDRANT – EA
- TEMPORARY PAVEMENT REPLACEMENT-LF

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit prices bid for the various items of the work. The price is full compensation for removal of existing water line components (line, fittings, services, etc.), furnishing, hauling, placing, and installing the materials; for inspecting, disinfection, and testing; and for other materials, labor, equipment, tools, and incidentals. All joint restraints, tees, fittings, reducers, metal detectable table, etc. are considered subsidiary to the individual line items for water line installation.

SECTION 15073

HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install, test, and place in satisfactory service high density polyethylene (HDPE) pipe and fittings.

B. Related work specified elsewhere that shall apply to all equipment, materials, labor and services furnished under this section shall include, but not be limited to, the following:
   1. Section 02220, Excavation and Backfill.
   2. Section 15051, Buried Piping Installation.
   3. Section 15100, Valves and Appurtenances.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM F 412 - Standard Terminology Relating to Plastic Piping Systems.
   2. ASTM D 618 – Standard Practice for Conditioning Polyethylene Plastic Pipe Based on Controlled Outside Diameter.
   3. ASTM F 714 - Standard Specification for 3 - 63 inch (SDR-PR) Polyethylene Pipe.
   4. ASTM D 1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
   5. ASTM F 1248 - Standard Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe
   6. ASTM D 2122 - Determining Dimensions of Thermoplastic Pipe and Fittings.
   7. ASTM D 2657 - Standard Practice for Heat-Joining Polyolefin Pipe and Fittings.
   8. ASTM D 2774 - Underground Installation of Thermoplastic Pressure Piping.
   9. ASTM D 2837 - Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pressure Piping.
   10. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR), Based on Outside Diameters.

11. ASTM D 3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
12. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
13. NSF Standard #14 - Plastics Piping Component and Related Material.
14. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch, for Water Service.
15. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch, for Water Distribution.

B. Manufacturer's and Installer's Qualifications:
   1. Manufacturer shall have at least five years experience in producing, and installer shall have at least five years experience in installing similar type materials, and show evidence with their submittals of at least five installations similar to this project in satisfactory operation.
   2. HDPE pipe joint fusion and installation shall be completed by the qualified installer approved by the ENGINEER, or by the CONTRACTOR under direct and continuous supervision of the qualified installer. All installation shall be completed in accordance with the approved Installation Plan described in paragraph 1.3.C.

C. The pipe and fittings manufacturer shall have an established quality assurance program responsible for inspecting incoming and outgoing materials. At a minimum, incoming polyethylene materials shall be inspected for density per ASTM D 1505 and melt flow rate per ASTM D 1238. The ENGINEER may require polyethylene materials certification from the supplier. Certification shall be verified by CONTRACTOR and ENGINEER. Incoming materials shall be approved by Manufacturer's Quality Assurance before processing into finished goods.

D. The pipe and fittings manufacturer shall have an established quality assurance program responsible for assuring the long-term performance of materials and products. Representative samples of polyethylene materials shall be tested against the physical property requirements of this specification. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D 1598.

E. Quality assurance test for representative pipe and fitting samples shall include:

Table 1

Test	Standard	Pipe	Fittings
Ring ESCR	ASTM F 1248	Yes	Not Applicable

Test	Standard	Pipe	Fittings
Sustained pressure at 176°F & 725 psi hoop stress (f_o>100 h)	ASTM D 1598	Yes	Yes
Sustained pressure at 73°F & 1600 psi hoop stress (f_o>1000 h)	ASTM D 1598	Yes	Yes

F. All outgoing materials shall be inspected for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Manufacturer's Quality Control shall perform tests of density, melt flow rate, carbon content, and carbon dispersion on finished pipe. In addition, samples of the pipe provided shall be tested for hoop tensile strength and ductility by either quick burst per ASTM D 1599 or ring tensile per ASTM D 2290. Molded fittings shall be subject to x-ray inspection for voids, and tests for knit line strength. All fabricated fittings shall be inspected for fusion quality and alignment.

G. The pipe and fitting manufacturer shall maintain permanent QC and QA records.

H. Pre-approved pipe manufacturer and installer include:
1. Phillips Petroleum, Driscopipe (manufacturer)
2. CSR Polypipe (manufacturer)
3. Chevron, Plexco (manufacturer)
4. Maskell-Robbins, Houston, TX (installer)
5. Industrial – Utility Sales Co., Houston, TX (installer)

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval detailed drawings and data on pipe fittings, specials, and appurtenances.

B. Design calculations, including determination of minimum wall thickness satisfactory for external or special loading and internal pressure for the intended service conditions.

C. Installation Plan: Detailed procedures to be used in joining and installing piping system including manufacturer’s recommendations. Field quality control practices for installation, including oversight quality control by the approved installer if installation will be completed by the CONTRACTOR.

D. Bill of Materials: Indicating material composition of pipe, pressure rating, nominal size with wall dimensions, and its location on the piping installation drawing(s).

E. Materials Certificates of Conformance: Submit material data sheets or certificates of conformance with referenced standards.

F. Manufacturer's Qualifications: In accordance with Article 1.2 of this Section.

G. Installer's Qualifications: In accordance with Article 1.2 of this Section. Pipe and fittings joints shall be heat fused by a qualified technician; trained by an approved manufacturer's representative in accordance with the manufacturer's recommended fusion procedures. Training must have occurred within the previous 12 months, or submit verifying experience within the previous 12 months for all technicians performing heat fusion on polyethylene pipe and fittings. Any CONTRACTOR's personnel proposed to complete pipe and joint fittings fusion must meet and document the same qualifications. Only approved qualified installer's technicians or approved qualified CONTRACTOR's personnel shall complete fusion activities.

H. Pipe testing protocol.

I. Installer's record of welds temperature and pressure.

1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

A. The pipe and fitting manufacturer shall package products for shipment in a manner suitable for safe transport, safe from damage and contamination, by commercial carrier. When delivered, a receiving inspection shall be performed, and any shipping damage reported to the pipe and fittings manufacturer.

B. Pipe and fittings shall be handled, installed, and tested in accordance with manufacturer's recommendations, and the requirements of this specification. HDPE pipe shall not be dropped, rolled or pushed off from any height on delivery, storage or installation.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. Pipe and fittings shall be specially designed in accordance with AWWA C906 and manufacturer's recommendations for service intended, in accordance with the following:
   1. Exposed installation as shown on the Drawings.
   2. Working pressure: 165psi (DR-13.5).

2.2 PHYSICAL PROPERTIES

A. Materials used for the manufacture of polyethylene pipe and fittings shall meet the following minimum physical property requirements:

Table 2
Physical Property Requirements

Property	Unit	Specification	Nominal Value
Material Designation	-	PPI/ASTM	PE 3408
PPI Material Listing	-	PPI TR-4	PE 3408
Material Classification	-	ASTM D 1248	III C 5 P34
Cell Classification	-	ASTM D 3350	345444C or 355444C
Density	g/cm^3	ASTM D 1505	>0.941
Flow Rate	g/10 min	ASTM D 1238 (190/21.6)	8.5
Flexural Modulus	psi	ASTM D 790	>110,000
Tensile Strength @ Yield	psi	ASTM D 638	3,000 – 5,000
ESCR	hours	ASTM D 1693	F_o> 10,000
Hydrostatic Design Basis @ 23°C (73°F)	psi	ASTM D 2837	1,600
UV Stabilizer (C)	% carbon black	ASTM D 1603	2 to 3
Elastic Modulus	psi	ASTM D 638	130,000
Brittleness Temperature	°F	ASTM D 746	≤-180
Vicat Softening Temperature	°F	ASTM D 1525	255
Thermal Expansion	in/in/°F	ASTM D 696	8 x 10E-5
Hardness	Shore D	ASTM D 2240	65
Molecular Weight Category	-	-	Extra High
Tensile Strength @ Ultimate	psi	ASTM D 638	5,000

B. There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Paragraph 2.4

C. Ring Stiffness Constant (RSC) values for corrugated pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.). The minimum RSC is 90% of the nominal.

D. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

E. Clean rework or recycled material generated by the manufacturer's own production may be used as long as the pipe or fittings produced meet all the requirements of this specification.

2.3 PIPE AND FITTINGS

A. Dimensions:
   1. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size. Minimum standard laying lengths shall be 40 feet ± 2 inches.
   2. Fitting Dimensions: Fittings such as couplings, wyes, tees, adaptors, etc. for use in laying pipe shall have standard dimensions that conform to ASTM D 3261.

B. Pipe and fittings shall be produced from similar materials meeting the requirements of this specification. Special or custom fittings may be exempted from this requirement.

C. Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by ENGINEER. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.

D. Molded fittings shall meet the requirements of ASTM D 3261 and this specification. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the diameter and wall thickness specifications of the mating system pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. Upon request, the manufacturer shall provide an explanation of his production code.

E. Transition Fittings shall be stainless or M.J. Adapter kits with stainless steel stiffeners.

F. Polypropylene (PP) Transition Fittings: Provide flanged transition fittings constructed of polypropylene at connections of HDPE piping to existing polypropylene piping, where shown and required. Match existing polypropylene piping pressure rating and wall thickness. Where connecting to double wall polypropylene piping, carefully cut back outer pipe wall to allow proper heat fusion of flanged transition fitting to existing line. Complete heat fusion of polypropylene piping in accordance with pipe manufacturer's recommendations.

G. Marking:
   1. Each standard and random length of pipe and fitting in compliance with this standard shall be clearly marked with the following information.
      a. ASTM Standard Designation.
      b. Pipe Size.
      c. Class and Profile Number.

d. Production Code.
e. Standard Dimension Ratio.

H. Pipe Pig: (Sludge Lines)
1. Provide (4) four Foam Disk Pigs for cleaning maintenance of the sludge pipelines. Pig shall be single-piece construction, constructed of flexible polyurethane foam disks connected with polyurethane elastomer. Ends shall be polyurethane elastomer. Pig shall be designed or wastewater sludge line cleaning application, and shall be sized in accordance with manufacturer's recommendations for the line inside diameter. Pig foam density shall be as recommended by the manufacturer for sludge cleaning application.
2. Provide Foam Disk Pig as manufactured by Knapp Polly Pig (800-231-7205), or equal.

2.4 SOURCE QUALITY CONTROL

A. The pipe and fitting manufacturer shall certify that samples of his production pipe have undergone stress regression testing, evaluation, and validation in accordance with ASTM D 2837 and PPI TR-3. Under these procedures, the minimum hydrostatic design basis shall be certified by the pipe and fitting manufacturer to be 1,600 psi at 73.4°F and 800 psi at 140°F.

B. Material shall be listed in the name of the pipe and fitting manufacturer as required by the Plastics Pipe Institute (PPI) in PPI TR-4 with the following Standard Grade ratings:

	73.4°F	140°F
1. Hydrostatic Design Basis (HDB)	1,600 psi	800 psi
2. Hydrostatic Design Stress (HDS)	800 psi	400 psi

C. PPI material listing in the name of the resin supplier is not acceptable alone in meeting this requirement.

D. Inspection Requirements:
1. Notification: If inspection is specified by the purchaser, the manufacturer shall notify the purchaser in advance of the date, time and place of testing of the pipe in order that the purchaser may be represented at the test.
2. Access: The OWNER's representative shall have free access to the inspection area of the manufacturer's plant. The manufacturer shall make available to the OWNER'S representative, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this specification.
3. Certification: As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance of these specifications upon request. When prior agreement is being made in writing between the purchaser and the manufacturer, the manufacturer will furnish other conformance certifica-

tion in the form of affidavit of conformance, test results, or copies of test reports.

E. Physical Test Requirements:
   1. Sampling: The selection of the sample of pipe shall be as agreed upon by the purchaser and the manufacturer. In case of no prior agreement, any sample selected by the manufacturer shall be deemed adequate.
   2. Sample size for flattening test will be one sample per size and class of corrugated pipe per project.
   3. Conditioning: Conditioning of samples prior to and during tests are subject to approval by OWNER. When reference tests are required, condition the specimens in accordance with Procedures defined in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity not less than 40 hours prior to the test. Conduct tests under the same conditions of temperature and relative humidity unless otherwise specified.

F. Test Methods:
   1. Flattening: Three specimens of pipe, a minimum of 12 inches long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. Remove the load, and examine the specimens for splitting cracking or breaking.
   2. Pipe Ring Stiffness Constant (Corrugated Pipe): The pipe ring stiffness constant shall be determined utilizing procedures similar to those outlined in ASTM D 2412. The stiffness of HDPE pipe is defined in terms of the load, applied between parallel plates, which causes 1% reduction of pipe diameter. Test specimens shall be a minimum of two pipe diameters or 4 feet in length, whichever is less.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to Specifications or following:
   1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 in. in length at either end of pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than 5% of shipment or delivery.
   2. Cracks sufficient to impair strength, durability or serviceability of pipe.
   3. Defects indicating improper proportioning, mixing, and molding.
   4. Damaged ends, where such damage prevents making satisfactory joint.

B. Acceptance of fittings, stubs or other specifically fabricated pipe sections shall be based on visual inspection at job site and documentation of conformance to these Specifications.

3.2 INSTALLATION

A. Heat Fusion of Pipe:
   1. Weld in accordance with manufacturer's recommendation for butt fusion methods. Provide fusion operators certified in writing by the fusion equipment manufacturer or pipe distributor.
   2. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by pipe manufacturer including, but not limited to, temperature requirements, alignment, and fusion pressures. . The butt-fused joints shall be in true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Installer shall record temperature and pressure for each weld and submit these records to the OWNER upon completion of the fusion Work. The joint shall be allowed to have adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER. All deflective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER shall be discarded and not used. Each finished weld shall be stamped by the Certified Installer. Stamp shall name installation company and identify installer by name or other identification.
   3. The equipment used for the heat fusion joints shall be capable of recording the heating and fusion pressures used to join the pipe, recording heater temperature, and storing this information for future retrieval. Each field fusion shall be recorded by such equipment and this information shall be made available to the field inspector.
   4. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
   5. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.
   6. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.

7. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.
8. Before butt fusing pipe, inspect each length for presence of dirt, sand, mud, shavings, and other debris or animals. Remove debris from pipe.
9. Cover open ends of fused pipe at the end of each working day. Cap to prevent entry by animals or debris.

B. Flange Jointing:
1. Use on flanged pipe connection sections.
2. Connect slip-on stainless steel (Type 304) flange backup rings as manufactured by Improved Piping Products or equal, with stainless steel (Type 304) nuts and bolts. Backup rings shall be specifically designed for HDPE flange applications providing a uniform alignment of the pipe. Exposed piping applications may use ductile iron flange backup rings.
3. Butt fuse fabricated flange adapters to pipe.
4. Observe following precautions in connection of flange joints.
   a. Align flanges or flange/valve connections to provide tight seal. Require nitrile-butadiene gaskets if needed to achieve seal. Gaskets are required for flange/valve connections.
   b. Place U.S. Standard round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
   c. Tighten flange bolts in sequence and accordance with manufacturer's recommendations. CAUTION: Do not over-torque bolts.
5. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendation.
6. Install electrofusion couplers, where used, per manufacturer's specifications.

C. Special Installation Requirements:
1. Lay exposed horizontal HDPE pipe in accordance with manufacturer’s recommendations for the temperature conditions at the time of installation, to avoid excessive tension or buckling with temperature changes within the anticipated service range conditions of between 0°F to 120°F. Where recommended by the manufacturer, install flanged expansion joints to relieve excessive thermal stresses anticipated for the service range conditions.

+ + END OF SECTION + +

WASTEWATER AIR RELEASE VALVE
Val-Matic Specification

1 Scope

1.1 This specification is intended to cover the design, manufacture, and testing of 2 in. (50 mm) through 4 in. (100 mm) Wastewater Air Release Valves suitable for pressures up to 150 psig (1000 kPa).

1.2 Wastewater Air Release Valves shall be automatic float operated valves designed to release accumulated air from a piping system while the system is in operation and under pressure. The capacity and pressure rating of the valve is dependent on the diameter of the precision orifice in the cover. A large inlet connection is required for proper air and water exchange. *[NOTE: See Wastewater Air/Vacuum Valves for exhausting and admitting large volumes of air and Wastewater Combination Air Valves for both air release and air/vacuum functions.]*

2 Standards, Approvals and Verification

2.1 Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.

2.2 Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

3 Design

3.1 The valves shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection. The body shall have 2" NPT cleanout and 1" NPT drain connections on the sides of the casting. The cover shall be bolted to the valve body and sealed with a flat gasket. A threaded adjustable orifice button shall provide drop tight shut off to the full valve pressure rating.

3.2 Floats shall be unconditionally guaranteed against failure including pressure surges. Extended mechanical linkage shall provide suitable mechanical advantage so that the valve will open under full operating pressure.

4 Materials

4.1 The valve body and cover shall be constructed of ASTM A126 Class B cast iron.

4.2 The orifice, float and linkage mechanism shall be constructed of Type 316 stainless steel. Non-metallic floats or linkage mechanisms are not acceptable. The orifice button shall be Buna-N.

5 Options

5.1 Backwash accessories shall be furnished when specified and shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose, and quick disconnect couplings. Accessory valves shall be quarter-turn, full ported bronze ball valves.

5.2 An optional vacuum check on the outlet shall be provided when specified to prevent air from re-entering the system during negative pressure conditions.

5.3 Optional body materials include ASTM A536 Grade 65-45-12 ductile iron, ASTM A351 Grade CF8M stainless steel, and ASTM B584 Alloy C83600 cast bronze.

5.4 Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550 when specified.

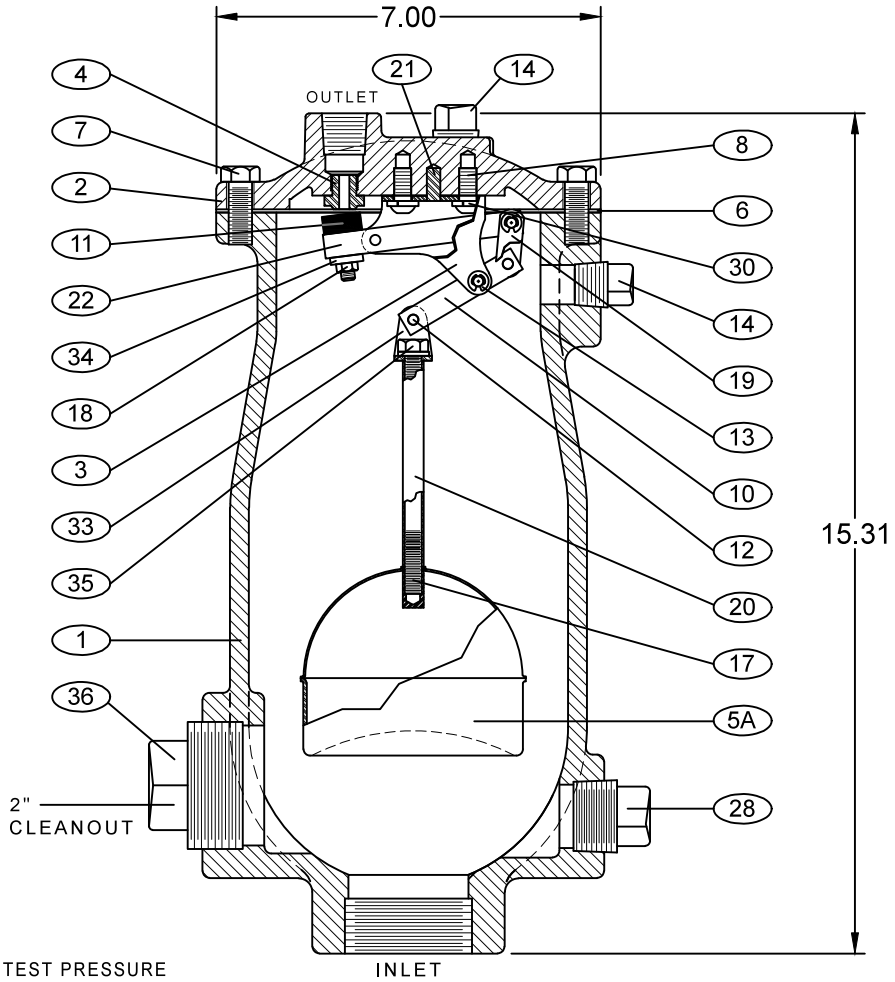
5.5 Low Durometer orifice button shall be furnished for low pressure applications.

6 Manufacture

6.1 The manufacturer shall demonstrate a minimum of five (5) years experience in the manufacture of wastewater air valves. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.

6.2 The exterior of the valve shall be coated with a universal alkyd primer.

6.3 Wastewater Air Release Valves shall be Series 48A and 49A as manufactured by Val-Matic Valve and Manufacturing Corporation, Elmhurst, Il, USA or approved equal.



TEST PRESSURE
1.5 TIMES COLD WORKING PRESSURE-CWP

SERIES NO. 48A					
INLET SIZE			2"	3"	4"
OUTLET SIZE			1/2"	1/2"	1/2"
COLD WORKING PRESSURE	75 PSI CWP	MODEL NO.	48A.4	48A.5	48A.6
		ORIFICE SIZE	5/16"	5/16"	5/16"
	150 PSI CWP	MODEL NO.	48A	48A.2	48A.3
		ORIFICE SIZE	3/16"	3/16"	3/16"
	300 PSI CWP	MODEL NO.	48A.7	48A.8	48A.9
		ORIFICE SIZE	5/32"	5/32"	5/32"

1	BODY	17	FLOAT RETAINER
2	COVER	18	LOCK NUT
3	LEVER FRAME	19	LINK
4	SEAT	20	EXTENSION SHAFT
5A	FLOAT	21	LOCATING PIN
6	GASKET	22	ORIFICE BUTTON ARM
7	COVER BOLT	28	PIPE PLUG
8	RETAINING SCREW	30	WASHER
10	FLOAT ARM	33	CLEVIS
11	ORIFICE BUTTON	34	LOCK WASHER
12	PIVOT PIN	35	RETAINING SCREW
13	RETAINING RING	36	PIPE PLUG
14	PIPE PLUG		

SEE DRAWING NO. VM-48A-M FOR STANDARD MATERIALS OF CONSTRUCTION.
SEE DRAWING NO. VM-48ADISV-M FOR SUPER VALVE MATERIALS OF CONSTRUCTION.

WASTEWATER AIR RELEASE VALVE

DATE 4-8-14

VAL-MATIC VALVE AND MANUFACTURING CORP.

DRWG. NO. VMC-48A

Special Specification 7004
Water Mains

1. DESCRIPTION

Furnish labor, materials, and equipment necessary to provide a complete water main system in conformance with the plans and Specifications, and in compliance with the Department's Utility Accommodations Policy (43 TAC § 21.31–21.55). Construct water mains of the sizes, materials, and dimensions shown on the plans, including pipe, joints, and connections to new and existing pipes; casing; valves; fittings; fire hydrants; meters; and blocking, as many as may be required to complete the work.

Furnish material and equipment for encasing existing water lines with split steel encasement pipes using the open-cut method in accordance with this Specification.

The abbreviations AWWA, ASA, ASTM, ANSI, AASHTO, NACE, NSF, SSPC, and TCEQ used in this Specification refer to the following organizations or technical societies.

- **AWWA**. American Water Works Association.
- **ASA**. American Standards Association.
- **ASTM**. American Society for Testing and Materials.
- **ANSI**. American National Standards Institute.
- **AASHTO**. American Association of State Highway and Transportation Officials.
- **NACE**. National Association of Corrosion Engineers.
- **NSF**. National Sanitation Foundation.
- **SSPC**. Steel Structures Painting Council.
- **TCEQ**. Texas Commission on Environmental Quality.

References to specifications of the above organizations mean the latest standard or tentative standard in effect on the date of the proposal.

2. MATERIALS

All materials must conform to the requirements of this Item, the plans, and the following Items.

- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 465, "Junction Boxes, Manholes, and Inlets"
- Item 471, "Frames, Grates, Rings, and Covers"

2.1. **General**. Provide new and unused materials for this project unless otherwise stated on the plans or in the proposal.

Pipe 6 in. or larger is acceptable to the Texas Fire Insurance Commission without penalty for use in water works distribution systems.

For water mains less than 24 in. in diameter, use casing insulators between the water main and casing unless otherwise shown on the plans. For water mains 4 in.–14 in., use 8-in. wide casing insulators.

For water mains 16 in.–20 in., use 12-in. wide insulators. For pipe materials up to 12 in., use Pipeline Seal and Insulator Model C8G-2 or approved equal. For water mains larger than 12 in., use Pipeline Seal and Insulator Model C12G-2 or approved equal. For casing end seals, use Pipeline Seal and Insulator Model C or approved equal.

2.2. **Steel Pipe and Fittings**.

2.2.1. **Steel Carrier Pipe**. Provide steel pipe for use as carrier pipe in the distribution system, conforming to AWWA C 200. Install steel pipe 20 in. or smaller as aerial crossings, aboveground piping, and for encasement sleeves only. Do not bury steel pipe that is 20 in. or smaller directly or within a casing.

For pipe 24 in. or greater, conform to AWWA C 200, C 207, C 208, and M 11, except as modified in this Specification. Furnish pipe and fittings that have manufacturer's certifications ensuring that they have been hydrostatically tested at the factory in accordance with AWWA C 200, Section 3.4. Ensure pipe steel meets ASTM A36; ASTM A570, Grade 36; ASTM A53, Grade B; ASTM A135, Grade B; or ASTM A139, Grade B, at minimum. Pipe is also subject to UL specification *Steel Pipelines for Underground Water Service*.

Provide pipe and fittings to withstand the most critical simultaneous application of external loads and internal pressures based on the minimum of AASHTO HS-20 loading, AREMA E-80 loads, depths of bury as indicated on the plans, and the most critical groundwater level condition. The pipe design conditions follow.

- **Working pressure**. 100 psi.
- **Hydrostatic field test pressure**. 150 psi.

For pipe design (24 in. and larger), conform to AWWA M 11 with the following conditions.

- **Design Stress Due to Working Pressure**. The maximum is 50% of the minimum yield strength or 16,500-psi maximum stress for mortar-coated pipe.
- **Design Stress Due to Hydraulic Test Pressure**. The maximum is 75% of the minimum yield strength or 24,750-psi maximum stress for mortar-coated pipe.
- **Modulus of Soil Reaction (E')**. <1,500 psi.
- **Unit Weight of Fill (w)**. >120 pcf.
- **Deflection Lag Factor (D1)**. 1.2.
- **Bedding Constant (K)**. 0.1.
- **Fully Saturated Soil Conditions**. hw = h = depth of cover above top of pipe.
- **Maximum Deflection from Specified Diameter**. 3% for flexible coatings.

Provide pipe and fittings that have been designed by a licensed professional engineer. Before manufacturing, submit these signed, sealed, and dated calculations for approval.

Supply pipe in double random lengths unless otherwise shown on the plans. Bevel the ends of the pipe for field butt-welding as shown on the plans.

Provide a minimum 3/8-in. inside joint recess between ends of pipe in straight pipe sections.

Provide a minimum allowable steel wall thickness in accordance with Table 1 and Table 2 for HS-20 live loads and depths of bury up to 16 ft.

Table 1
Carrier Pipe (20 in. and Smaller)

Nominal Pipe Size (in.)	Outside Diameter (OD) (in.)	Min Wall Thickness (in.)	Approximate Weight per Foot, Uncoated (lb.)
4	4.500	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.750	0.365	40.48
12	12.750	0.375	49.56
16	16.000	0.375	62.58
20	20.000	0.375	78.60

Table 2
Carrier Pipe (24 in. and Larger)

Net Inside Diameter (ID) (in.)	Min Wall Thickness (in.)	
	Flexible Coating	Mortar Coating
24	0.149	0.136
30	0.149	0.136
36	0.178	0.163

Note—Refer to the plans for carrier pipe thickness. However, never use a pipe wall thickness less than that defined in Table 1 and Table 2.

2.2.2. **Steel Casing Pipe**. Ensure pipe intended for use as casing pipe is manufactured in accordance with Section 2.2.1., "Steel Carrier Pipe," but ensure that the minimum allowable steel wall thickness conforms to those shown in Table 3 for HS-20 live loads and depth of bury of up to 16 ft.

Table 3
Casing Pipe (Encasement Sleeves)

30 in. and Smaller			
Casing Pipe Size (in.)	OD (in.)	Min Wall Thickness (in.)	Approximate Weight per Foot, Uncoated (lb.)
8	8.625	0.219	19.64
10	10.750	0.219	24.60
12	12.750	0.219	29.28
16	16.000	0.219	36.86
18	18.000	0.250	47.39
20	20.000	0.250	52.73
24	24.000	0.250	63.41
30	30.000	0.250	79.43

Note—Refer to the plans for casing thickness. However, never use a pipe wall thickness less than that defined herein.

Provide steel casing sections for split casing in lengths a maximum 20 ft. Ensure each section is split in half sections. Bevel the ends and split sections for field butt-welding.

Steel casing pipe is not required to carry the UL label.

2.2.3. **Steel Pipe Fittings**. Provide factory-forged steel pipe fittings unless otherwise shown on the plans. Ensure the wall thickness is equal to or greater than the pipe to which the fitting is to be welded. Bevel the ends of the fitting for field butt-welding.

Provide approved sleeve-type flexible and flange adaptor couplings. Ensure the thickness of the middle ring is equal to or greater than the thickness of the pipe wall.

Provide restraint joint connections for 16-in. and larger water main piping shown on the plans to have restraint lengths, unless otherwise shown on the plans. Joints must be double-welded at butt or lap joints at aerial crossings as shown on the plans. Use flanged joint at valves.

2.2.3.1. **Elbows**. Provide two-piece for 0°–22.5°, three-piece for 23°–45°, four-piece for 46°–67.5°, and five-piece for 68°–90°, unless otherwise shown on plans.

2.2.3.2. **Outlets**. Outlets must be reinforced in accordance with AWWA M 11, Section 13.3–Section 13.7; AWWA C 200; and AWWA C 208. Provide interior lining and exterior coating in accordance with paragraphs pertinent to coating and lining, and matching pipe to access inlets, service outlets, test inlets, and air vacuum valve and other outlets, including riser pipes.

2.2.3.3. **Radius**. The minimum radius is 2.5 times pipe diameter.

2.2.4. **Hydrostatic Test of Pipe**. Ensure the pipe manufacturer performs hydrostatic testing in accordance with AWWA C 200, Section 3.5.3, at the point of manufacture; conducts the test for at least 2 min.; and thoroughly inspects the pipe. Repair or reject pipe revealing leaks or cracks. Obtain from the manufacturer and submit to the Engineer the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

Calibrate pressure gauges within 1 yr. before testing, as specified in AWWA C 200, Section 1.04 L.

2.2.5. **Butt Straps for Closure Piece**. Provide a minimum 12-in. wide split butt strap, minimum plate thickness equal to the thinnest member being joined, and fabricated from material equal in chemical and physical properties to the thinnest member being joined.

Provide a minimum lap of 4 in. between the member being joined and the edge of the butt strap, welded on the inside and outside, unless otherwise approved.

Provide a minimum 6-in. welded outlet for inspecting each closure section, unless the access manway is within 40 ft. of the closure section. Provide forged-steel threaded outlets of approved design, where required, for use in passing hose or lead wires into the pipe. Tap plugs with standard pipe threads and weld to the pipe in an approved manner, using solid forged-steel plugs for closure.

Provide full-penetration butt or welded joints as shown on the plans. Use flanged joints at valves unless otherwise shown on the plans. Perform X-ray or ultrasonic testing of manual welds on special pipe and fittings.

Provide dished head plugs (test plugs) to withstand field hydrostatic test pressure from either side of the plug. Ensure the design stress due to hydrostatic pressure is at most 50% of minimum yield. Pipe on the opposite side of the hydrostatic test may or may not contain water. Ensure the manufacturer of the steel pipe hydrostatically tests the plugs at the factory.

Make curves and bends by deflecting joints, by using beveled joints, or by combining these methods, unless otherwise shown on the plans. Do not exceed the joint deflection angle recommended by the pipe manufacturer.

Make penetration of spigot into bell at all points of circumference at least equal to minimum required penetration shown on the plans. Provide beveled pipe sections used in curved alignment of standard length, except when shorter sections are required to limit the radius of curvature. In this case, provide equal-length sections throughout the curve. Do not allow the bevel to exceed 5°.

2.2.6. **Steel Pipe Flanges**. Ensure steel pipe flanges shown on the plans conform to AWWA C 207 for Class D flanges (same diameter and drilling as Class 125 cast iron flanges, ASA B 16.1).

Make cast-iron-to-steel pipe connections with one cast iron bell flange and one steel slip-on flange, and ensure they are electrically isolated.

The use of insulating gaskets, plastic bolt sleeves, and washers of insulating gasket material backed with zinc-plated or hot-dip galvanized washers, or epoxy-coated bolts, nuts, and washers used with an insulating gasket, is approved for this purpose.

For inline flange joints 12 in. in diameter and greater and for butterfly valve flanges, use Pyrex LineBacker Type E phenolic gaskets manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

Use full-face gaskets for other flanged joints not listed above. Provide cloth-inserted rubber gasket material, 1/8 in. thick in accordance with AWWA C 207. Ensure gaskets are factory-cut to proper dimensions.

Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers, and insulating-type gaskets, unless otherwise approved.

Fabricate flanges with oversize bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2.2.7. **Steel Pipe Protective Coatings**.

2.2.7.1. **General**. Use shop-applied protective coatings except for field repairs and coatings of field-welded joints. The Engineer may provide for witness of inspection and testing of shop-applied coatings; however, such witness does not relieve the Contractor of the responsibility to furnish material, perform work, and provide quality control (QC) in conformance with the applicable AWWA standard and these Specifications.

The substrate surface profile and minimum and maximum individual and total dry film thickness (DFT) indicated in this Specification apply. No requirement of this Specification cancels or supersedes the specific written directions and recommendations of the specific coating manufacturer so that the integrity of the applied system is not jeopardized. Measure the DFT in accordance with SSPC-PA 2.

Field-test shop coating and field repairs for holidays, pinholes, or discontinuities, at voltage levels required by the applicable AWWA standard and in accordance with the applicable NACE procedure (e.g., PRO 188, RPO 274, or TMD 384). Submit the test procedure, including voltage levels to be used, before testing. Repair holidays in conformance with the applicable AWWA standard.

Provide documentation by a NACE-certified inspector of compliance with the required tests.

Handle, store, and use field procedures for shop-coated pipe in conformance with the applicable AWWA standards. Adequately seal and protect pipe ends from damage during handling and storage. Do not remove such protection until immediately before installing. Do not lift pipe using caliper clamps or hooks at ends of the pipe.

Repair damage to the pipe or the protective coating caused while installing the pipe and before final acceptance by the owner, as directed and in conformance with the applicable standards.

Keep the interior of the pipe and fittings clean of foreign matter before installing and until the work is accepted. Keep joint contact surfaces clean until jointing is complete.

Furnish an affidavit of compliance that all materials and work furnished comply with the applicable AWWA standard and these Specifications.

2.2.7.2. **Internal Lining for Steel**. Ensure the material used for the internal coating of the steel carrier pipe is NSF-61 listed as suitable for contact with potable water as required by TCEQ, Chapter 290, “Rules & Regulations for Public Systems.”

Supply steel pipe with epoxy lining, capable of conveying water at temperatures no greater than 140°F. Provide linings conforming to ANSI/NSF 61, and certification from an organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, and access manhole covers with epoxy lining as specified.

2.2.7.2.1. **Epoxy Lining**. Use liquid epoxy meeting AWWA C 210, "Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines," except as modified in this Specification. Provide a liquid epoxy system consisting of three coats of polyamide epoxy (no coal-tar material) as follows.

- **Prime Coat**. Two-part, chemically cured, NSF-certified epoxy, 4-mil–6-mil DFT.
- **Intermediate Coat**. Two-part NSF-certified epoxy, 4 mils–6 mils (DFT).
- **Finish Coat**. Two-part NSF-certified epoxy, 4 mils–6 mils (DFT).

Ensure the total system has a minimum DFT of 12 mils and a maximum DFT of 18 mils. Apply each coat in contrasting colors, using a buff prime and intermediate coat and a white finish coat. Use the same manufacturer to supply all material. Coal-tar epoxy material is not permitted. For surfaces to be coated, abrasive-blast clean them to a near-white finish in accordance with SSPC-5(64) to establish an average anchor profile of 2.0 mils–3.0 mils, with no individual reading greater than 4.0 mils or less than 1.5 mils. Before applying, inspect the prepared and cleaned surface for evidence of nonvisible contaminants such as soluble salts or chlorides in accordance with NACE Technical Committee Report *Surface Preparation of Contaminated Steel Surfaces*, NACE Publication 6G 186.

Reclean the surface as necessary, until it is free of such contaminants.

Perform an interior adhesion test on pipe 30 in. in diameter and larger in accordance with ASTM D4541.

Minimum field adhesion must be 700 psi. Perform this test on pipe for project at a frequency of one for every 1,000 sq. ft. of epoxy lining. Perform a cure test in accordance with ASTM D4752 (solvent rub test) and ASTM D3363 (pencil hardness) for each section of pipe. Repair tested areas using approved procedures.

Provide fusion-bonded epoxy in accordance with AWWA C 213, "Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines."

2.2.7.3. **External Coating**.

2.2.7.3.1. **Above Ground**. Externally coat aboveground steel piping and fittings with a three-coat epoxy/epoxy/polyurethane system in accordance with AWWA C 218, "Coating the Exterior of Aboveground Steel Water Pipelines and Fittings," Section 2.5, Coating System No. 4-91, except as modified in this Specification.

- **Prime Coat**. Two-component, inhibitive epoxy primer, DFT of 4 mils–6 mils.
- **Intermediate Coat**. Two-component, chemical-resistant epoxy, DFT of 4 mils–6 mils.
- **Finish Coat**. Two-component aliphatic polyurethane, DFT 1.5 mils–2.5 mils.

Ensure the total system has a minimum DFT of 9.5 mils and a maximum DFT of 14.5 mils. Apply each coat in contrasting colors, using a buff prime coat and a blue finish coat, or as directed. Use the same manufacturer to supply all material. For surfaces to be coated, abrasive-blast clean them to a near-white finish in accordance with SSPC-SP 10 (NACE 2) to establish an average anchor profile of 2.0 mils–3.0 mils, with no individual reading greater than 4.0 mils or less than 1.5 mils. Before coating, inspect the prepared and cleaned surface for evidence of nonvisible contaminants such as soluble salts or chlorides in accordance with NACE Technical Committee Report *Surface Preparation of Contaminated Steel Surfaces*, NACE Publication 6G 186. Reclean the surface as necessary, until it is free of such contaminants.

Perform an interior adhesion test on pipe 30 in. in diameter and larger in accordance with ASTM D4541. Minimum field adhesion must be 700 psi. Perform this test on pipe for the project at a frequency of one for

every 1,000 sq. ft. of epoxy lining. Perform a cure test in accordance with ASTM D4752 (solvent rub test) and ASTM D3363 (pencil hardness) for each section of pipe. Repair tested areas using approved procedures.

Provide fusion-bonded epoxy in accordance with AWWA C 213, "Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines."

2.2.7.3.2. **Buried Steel Pipe, 24-in. Diameter and Larger Only**. Coat buried steel pipe and fittings (except tunneled, cased, or augered holes) using either of the following systems.

2.2.7.3.2.1. **Tape Coating**. Provide an approved tape for external tape coating. Apply in accordance with AWWA C 214 and this Section, 80-mil shop-applied Polyken YG-III, Tek-Rap Yard-Rap, or approved equal. Components must include primer, one 20-mil layer of inner-layer tape for corrosion protection, and two 30-mil layers of outer-layer tape for mechanical protection. Bond coupling to adjacent pipes with bonding cables as shown on the plans.

Use approved filler putty, Type Polyken 939 insulating putty, or approved equal, to fill in the gap and create a smooth sloped transition between the top of the reinforcing plate and the pipe, before applying the tape coating.

Primer compatible with the tape coating must be supplied by the coating system manufacturer.

Provide pipe with shop coatings cut back approximately 4 in.–4-1/2 in. from the joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1-in. staggers to facilitate field-wrapping and welding of joints. Inner and outer tape width must be 12 in. or 18 in.

Do not expose tape coating to direct sunlight for more than 60 days.

Wrap specials and fittings that cannot be machine-wrapped due to configuration with primer layer and two layers of prefabricated tape, each 35 mils thick. Overlap machine-applied tape with hand-applied tape by at least 2 in. and bind to it.

Apply Polyken approved 30-mil Filler Tape 931, or approved equal, parallel to spiral weld seams if weld height measures greater than or equal to 1/8 in.

2.2.7.3.2.2. **Polyurethane Coating**. Refer to Section 2.2.7.3.1., "Above Ground." Heat-shrink joint sleeves for tape coating must be Aqua-shield or approved equal. For repairs to heat-shrink joint sleeves, use Aqua-shield repair patch kit, or approved equal.

2.2.7.3.3. **Steel Pipe in Tunneled, Cased, Bored, or Augered Holes**.

2.2.7.3.3.1. **24-in. and Larger**. Prime steel pipe in tunneled or cased holes with 3.0 mils–4.0 mils of a two-part chemically cured rust-inhibitive polyamide epoxy. Prepare the surface the same as for aboveground external coating in accordance with Section 2.2.7.3.1., "Above Ground." Fill the annular space between the tunnel or casing with the specified grout.

2.2.7.3.3.2. **20-in. and Smaller**. Coat steel pipe in bored or augered holes, or holes in a tunnel or casing, with Corropipe II-TX or Corroclad 2000 as manufactured by Madison Chemical Industries, Inc., or approved equal, and apply in strict conformance with the manufacturer's recommendations.

For external field welds and other field repairs, use Madison Chemical "GP" II or "TX" Touch Up, or approved equal, in conformance with the manufacturer's recommendations.

2.2.7.4. **Inspections and Testing of Coatings**. Perform electrical inspection on the inner layer of tape before applying the intermediate layer of tape. If holidays are detected, repair holidays immediately before applying the outer layer of tape. Clear the holiday area of material and reprime if necessary. Recoat the area with

inner wrap tape. Overlap the inner wrap tape onto the surrounding inner wrap coating by at least 2 in. Perform an electrical retest at the repaired area after repairing the holiday, and before continuing the outer wrap.

Perform an electrical inspection on the shrink wrap to check for holidays. Perform peel tests over the heat-affected zone. Minimum acceptable result is 15 lb. ft. per inch.

2.3. **Ductile Iron Pipe (DIP) and Fittings**.

2.3.1. **DIP**. Provide DIP conforming to AWWA C 151. Provide minimum lengths of 18 ft. and minimum thickness of Class 51 for water lines. Provide minimum thickness of Class 53 for flanged pipe and minimum thickness of Class 52 for areas with pipe offset sections. Use joints of the push-on type or flanged type unless otherwise shown on the plans. Use push-on joints conforming to ASA A 21.11 (AWWA C 111). Use flanged joints conforming to AWWA C 115, including a cloth inserted rubber gasket material 1/8 in. thick for flanged joints. Do not use threaded- or grooved-type joints, which would reduce the pipe wall thickness below the minimum required.

Provide polyethylene encasement material and install in accordance with AWWA C 105, and backfill as specified. Apply at least two complete wraps of 8-mil thick polyethylene. Use polyethylene encasement for open-cut installations only. For augered sections or sections installed inside a tunnel or casing, provide polyurethane coating.

Ensure the pipe manufacturer performs hydrostatic testing in accordance with AWWA C 151, Section 5.2.1, at the point of manufacture; conducts the test for at least 2 min.; and thoroughly inspects the pipe. Repair or reject pipe revealing leaks or cracks. Obtain from the manufacturer and submit to the Engineer the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

Prevent any lateral movement of thrust restraints throughout the pressure-testing and operation. Passive resistance of soil is not permitted in the calculation of thrust restraint.

Clearly mark the pipe section to show the location and thickness or pressure class color code.

Provide an exterior coating, in open-cut excavations, consisting of a prime coat and an outside asphaltic coating conforming to AWWA C 110, C 115, or C 151 for pipe and fittings. Encase the water line in a double wrap of polyethylene. Use polyethylene wrap conforming to Section 2.13., "Polyethylene Film Wrap," and Section 3.16., "Polyethylene Film Wrap." Install bond wire as specified.

Coat DIP in augered holes with a polyurethane coating. Use a polyurethane coating conforming to the same requirements as those in Section 2.2.7.3.3., "Steel Pipe in Tunneled, Cased, Bored, or Augered Holes."

2.3.2. **Fittings for DIP**. Ensure fittings for use with DIP of nominal sizes 4 in.–48 in. conform to AWWA C 110 or AWWA C 153.

Use joints of the push-on type or flanged type unless otherwise shown on the plans. Use push-on joints conforming to ANSI A 21.11 (AWWA C 111), rated for a 250-pounds per square inch gauge (psig) working pressure, or AWWA A 21.53 (AWWA C 153). Use flanged fittings conforming to AWWA C 110, of cast or ductile iron and conforming to ANSI B 16.1, Class 125, rated at 250-psig working pressure. Screw flanged fittings on threaded pipe ends done in the shop in accordance with AWWA C 115 for attaching, aligning, and facing.

Coat the inside and outside surfaces of the fittings as specified for the regular lengths of DIP.

Regardless of the coating system, for flanged joints in buried service, provide a petrolatum wrapping system, Denso, or approved equal, for the complete joint and alloy steel fasteners. Alternately, provide bolts made of Type 304 stainless steel.

Bond joints in accordance with Section 2.6., "Joint Bonding and Electrical Insulation."

2.3.3. **Restrained Joints**. For buried services, restrain DIP 16 in. in diameter and larger from movement, using special joints. Provide the following or approved equal.

- Super-Lock Joint by Clow Corporation
- Flex-Ring or Lok-Ring by American Cast Iron Pipe Company
- TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company

Provide restrained joints with enough distance from each side of the bend, tee, plug, or other fitting to resist thrust developed at the design pressure for the pipe.

Use water main interior coatings conforming to AWWA C 104 or ANSI A 21.4, cement-lined with seal coat, or ANSI A 21.16 fusion-bonded epoxy coating.

Ensure the material used for internal coating is NSF 61 and listed as suitable for contact with potable water as required by Texas Natural Resources Conservation Commission, Chapter 290, "Rules and Regulation for Public Water Systems."

2.4. **Polyvinyl Chloride (PVC) Pipe and Fittings**.

2.4.1. **PVC Pipe, 2-in.–20-in**. Provide PVC pipe 4 in. and larger with integral bell-type gasketed push-on joints or plain-end pipe with twin-gasketed couplings conforming to ASTM D 3139 for push-on type joints. Use rubber gaskets conforming to ASTM D 1869. Lubricate gaskets with a nontoxic water-soluble lubricant before joining pipe units. Fit pipe units together in a manner to avoid twisting or damaging the rubber gasket.

Mark furnished PVC pipe on the spigot end for proper depth of makeup to the bell end of a joining length of pipe or fitting.

Provide valves for use with PVC pipe conforming to Section 2.9., "Gate Valves, Tapping Valves, and Tapping Sleeves," but provide valve ends of the push-on joint type for use with PVC pipe. Provide self-extinguishing PVC pipe that bears the UL mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines. Ensure PVC pipe bears the NSF Seal of Approval (NSF-PW).

Provide PVC meeting the following thicknesses when using restrained joints.

- **DR 18**. For restrained joints where shown on the plans.
- **DR 14**. For alternate to offset pipe sections shown on the plans. Do not use PVC pipe for offset sections with depth cover greater than 20 ft. or less than 4 ft. Do not use PVC pipe in potentially petroleum-contaminated areas.

Make curves and bends by deflecting joints. Do not exceed the maximum deflection recommended by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Engineer.

2.4.1.1. **Gaskets**. Use gaskets meeting ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.

2.4.1.2. **Flat Face Mating Flange**. Full faces 1/8-in. thick ethylene propylene rubber (EPR).

2.4.1.3. **Raised Face Mating Flange**. Flat ring 1/8-in. EPR, with filler gasket between the OD of the raised face and the flange OD to protect the flange from the bolting moment.

2.4.1.4. **Lubricant for Rubber-Gasketed Joints**. Water-soluble, nontoxic, and nonobjectionable in taste and odor imparted to fluid; nonsupporting of bacteria growth; and causing no deteriorating effect on PVC or rubber gaskets.

Use one manufacturer to furnish PVC pipe. When an approved PVC system is used as alternate to offset pipe section, a second manufacturer may be used. Do not use PVC pipe in potentially or known contaminated areas. Do not use PVC pipe in areas exposed to direct sunlight.

Ensure the pipe manufacturer performs hydrostatic testing in accordance with AWWA C 900, AWWA C 905, AWWA C 909, and ANSI A 21.10 (AWWA C 110) at the point of manufacture. Obtain from the manufacturer and submit to the Engineer the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

2.4.2. **Fittings for PVC Pipe, 2-in**. Provide PVC pipe manufactured in accordance with ASTM D1784 for PVC 12454B (Type I, Grade 1) or PVC 12454C (Type I, Grade 1) and with a standard thermoplastic pipe dimension ratio equal to 21.

Use fittings for 2-in. PVC pipe with a minimum pressure rating of 200 psi. Use fittings of the solvent-weld, socket-type conforming to ASTM D2466, or the gasketed push-on type conforming to ASTM D2241. Use PVC solvent cements manufactured in accordance with ASTM D2564.

2.4.3. **PVC Pipe, 4-in.–20-in**.

- **PVC Pipe 4-in.–12-in**. AWWA C 900; AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14, as alternate to offset pipe sections; nominal 20-ft. lengths; cast-iron equivalent ODs.
- **Pipe 14-in.–20-in**. AWWA C 905, Class 235, DR 18; nominal 20-ft. lengths; cast-iron equivalent OD.

Use joints conforming to the same requirements as those specified for 2-in. PVC pipe.

2.4.4. **Bends and Fittings for PVC Pipe, 4-in.–20-in**. Provide fittings conforming to Section 2.3.2., "Fittings for DIP." Use polyethylene-wrapped fittings as required by Section 2.13., "Polyethylene Film Wrap," and Section 3.16., "Polyethylene Film Wrap."

Provide restrained joints with enough distance from each side of the bend, tee, plug, or other fitting to resist thrust developed at the design pressure for the pipe.

Approved Certa-Lok PVC restrained joints, 200 psi–250 psi, may be provided for up to 12 in. in diameter. Where preventing movements of 12-in. diameter or greater pipe due to thrusts is necessary, provide the following restrained joints, or approved equal.

2.4.4.1. **Fittings**. JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc., or Series 500 Fitting Restrainer by Ebba Iron, Inc.; One Bolt by One Bolt, Inc.; or approved equal.

2.4.4.2. **Bell and Spigot**. JCM 620 or 621 Sur-Grip Bell Joint Restrainer by JCM Industries, Inc., or Series 1500 or Series 1100HV Joint Restrainer by Ebba Iron, Inc.; One Bolt by One Bolt, Inc.; or approved equal.

2.4.5. **Nonmetallic Pipe Detection.** Where nonmetallic pipe is installed longitudinally under ground, provide for a method of detecting the location of the nonmetallic pipe. The specific method is shown on the plans or will be approved. This system may involve some components to be installed in the trench around the pipe to be detected using a metal detector. Or the system may consist of locating equipment capable of creating a nondestructive pressure wave that can be detected above ground using a portable detection device with audible and visual indicators. Ensure either system of detection is capable of accurately locating the pipe to a maximum depth of 3 ft. over the areas shown on the plans.

Either system must be capable of locating lines under earth, concrete, or asphaltic surfaces. Use equipment, materials, and installation as specified by the manufacturer.

2.5. **Fiberglass-Reinforced Plastic (FRP) Pipe for Casing**.

2.5.1. **FRP Casing Pipe**. Ensure pipe used for casing is centrifugally cast fiberglass pipe conforming to AWWA C 950 and this Section.

Design fiberglass casing pipe wall thickness to withstand the most critical simultaneous application of external loads, including construction loads and internal pressures. Base the design on the minimum of AASHTO HS-20 loading, AREMA E-80 loads, and depths of bury as indicated on the plans. Design for the most critical groundwater level condition. The pipe design conditions follow.

- **Working Pressure**. 100 psi.
- **Hydrostatic Field Test Pressure**. 150 psi.

Provide the pipe with pressure-rated fiberglass sleeve couplings or O-ring bell-and-spigot joints that use elastomeric sealing gaskets to maintain joint watertightness conforming to ASTM D 4161. Provide the casing end treatments with rubber-boot type seals capable of maintaining casing watertightness. Provide casing pipe, gasketing, and end treatments that have a very low to zero corrosive reaction to the chemicals listed on the pipeline product lines shown on the plans. The pipeline products encountered at proposed water line crossings include, but are not limited to, the following.

- Methyl tertiary butyl ether
- Tertiary butyl arsine
- Nitrogen
- Benzene
- Petroleum
- Natural gas
- Ethane

Provide pipe manufactured with an epoxy vinyl ester resin with the physical and chemical properties of HETRON 970-35 by Ashland or approved equal.

Provide fiberglass casing sections in nominal lengths of 20 ft. Provide a stiffness class of fiberglass pipe that satisfies design requirements, but no less than 46 psi, when used in direct-bury operation. For tunneled and augered sections, use pipe and pipe joints designed to carry loads including, but not limited to, overburden and lateral earth pressures, subsurface soil, grouting, other conditions of service, thrust of jacks, and stress anticipated during handling and installation. Do not create grout holes using pipe.

Submit shop drawings signed and sealed by a licensed professional engineer in the State of Texas showing the following.

- Manufacturer's pipe design calculations, including thrust restraint design.
- Details of pictorial nature of critical features and specials indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and fully dimensioned details, with plan view detailing pipe invert elevations, bends, and other critical features. Indicate station numbers for fittings corresponding to the plans. Do not start production of pipe and fittings before review and approval. Provide final approved lay schedule on CD-ROM in Adobe Portable Document Format (*.PDF).
- Certification from manufacturer that design was performed for the project in accordance with this Section. This certification must be signed and sealed by a licensed professional engineer in the State of Texas.
- Gasket and resin selection for approval.

2.6. **Joint Bonding and Electrical Insulation**. For electrical bond wires, use a minimum No. 2 AWG, seven-strand, copper cable, furnished with high molecular weight polyethylene (HMWPE) insulation. Remove 1 in. of HMWPE insulation from each end of the bond wire. Provide two bond wires as shown on the plans.

Provide a flange adaptor with an insulating kit, as required, when connecting new piping to existing piping and piping of different materials. Provide electrical flange insulation by the installation of the following materials.

2.6.1. **Insulating Gasket**.

2.6.1.1. **Piping Size 30 in. in Diameter and Greater**. Provide Pyrox G-10 with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

2.6.1.2. **Piping Size Between 12 in. and 24 in. in Diameter**. Provide Phenolic PSI with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

The Contractor may provide a plain-faced phenolic gasket, as manufactured by Pipeline Seal and Insulator, Inc., or approved equal. Place the phenolic gasket between two full-faced gaskets. Provide cloth-inserted rubber gasket material, 1/8 in. thick, in accordance with AWWA C 207. Use gaskets that are factory-cut to proper dimensions.

2.6.2. **Sleeves and Washers**.

2.6.2.1. **Piping Size 30 in. in Diameter and Greater**. Provide full-length Mylar sleeves with Pyrox G-10 washers, double-washer sets as manufactured by Pipeline Seal and Insulator, Inc., or equal.

2.6.2.2. **Piping Size Between 12 in. and 24 in. in Diameter**. Provide full-length Mylar sleeves with phenolic washers, double-washer sets as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

2.7. **Copper Tubing for Copper Service Lines and Small Mains**. For 3/4-in., 1-in., 1-1/2 in., and 2-in. diameter copper tubing for underground service, use Type K soft annealed and seamless with the proper bending temper and conforming to ASTM B88 and Federal Specification WW-T-799, with the following exceptions.

ASTM B88, Section 14, is modified to provide for one sample for each 7,500 ft. of tubing and items of less than 7,500 ft. of tubing.

Furnish 3/4-in. and 1-in. tubes in 60-ft. coils. Furnish 1-1/2 in. and 2-in. tubes in coils at least 40 ft. long. Use minimum joint spacing in multiples of 60 ft. or 40 ft., respectively.

Provide flared or compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C 800.

2.8. **Brass Fittings for Underground Services Lines and Small Mains (Less than 24 in. in Diameter)**.

2.8.1. **General**. Unless otherwise provided in this Specification, use brass fittings in underground installations of service lines and small mains in the water distribution system.

Use brass fittings consisting of Copper Alloy No. C 83600 conforming to ASTM B62. Ensure the general pattern for each fitting conforms to that of standard brass fittings as manufactured by Mueller Company, Hays Manufacturing Company, or an approved equal.

Compression fittings may be used for unions except where they occur under existing or future paving. Use compression tube fittings with Buna-N beveled gaskets.

Ensure each fitting has the manufacturer's name or trademark and size plainly stamped into or cast on the body. Provide straight pipe adjacent to fittings for at least 10 in.

Provide waterways no smaller in diameter than the nominal size of the stop and accurately finish to a watertight joint; face all nuts and washers to a true fit; and design them such that the joint remains watertight and easy to operate after repeated use over several years. Use external threads conforming to AWWA C 800, and, on corporation stops, protect them in shipment using plastic coatings or an alternate approved method.

2.8.2. **Corporation Stops**. Provide inlet ends of one of the following types.

- Standard corporation stop threads as specified in AWWA C 800, Table 1
- Iron pipe thread (permissible for use with service saddles only)
- Hays 4200–4202 or approved equal

Use one of the following types of valve body.

- Tapered plug
- O-ring seat ball
- Rubber seat ball

Provide outlet ends with a flared-copper connection for use with Type K soft copper or compression-type fitting.

For PVC pipe, provide all brass corporation stops specifically designed for use with PVC pipe.

2.8.3. **Curb Stops**. Provide inlet ends with flared copper connections or compression-type fittings.

Use a valve body with a straight-through or angled meter stop design equipped with padlock wings and of the O-ring seal straight plug type or the rubber seat ball type.

Provide the outlet with female iron pipe threads or swivel nut meter spud threads, 3/4-in. and 1-in. stops, and with two-hole flanges for 1-1/2 in. and 2-in. sizes.

2.8.4. **Service Saddles**. Provide service saddle with dual straps and one of the following types:

- Brass body and straps
- Ductile iron body and straps, vinyl-coated
- Ductile iron body, vinyl-coated with stainless steel straps

For taps for PVC water mains, use dual-strap or single, wide-band strap saddles that provide full support around the circumference of the pipe and a bearing area with enough width along the axis of the pipe, 2 in. minimum, to ensure that the pipe will not be distorted when the saddle is tightened. Use Romac Series 101N wide-band, stainless steel tapping saddle with AWWA standard thread (Mueller thread) or approved equal.

2.8.5. **Angle Stops**. Provide angle stops in accordance with AWWA C 800; ground-key stop type with bronze lock-wing head stop cap; inlet and outlet threads conforming to the application tables of AWWA C 800; and inlet side with a flared connection or Mueller 110 compression type, or an approved equal.

2.8.5.1. **Outlet for 3/4-in. and 1-in. Size**. Provide meter swivel nut with saddle support.

2.8.5.2. **Outlet for 1-1/2 in.–2-in. size**. Provide O-ring sealed meter flange, iron pipe threads.

2.8.6. **Fittings**. Provide fittings in accordance with AWWA C 800 and as described below.

2.8.6.1. **Castings**. Smooth, free of burrs, scales, blister, sand holes, and defects that would make them unfit for their intended use.

2.8.6.2. **Nuts**. Smooth cast and with symmetrical hexagonal wrench flats.

2.8.6.3. **Flare Joint Fittings**. Smooth cast. Machine seating surfaces for metal-to-metal seal, to proper taper or curve, free of any pits or protrusions.

2.8.6.4. **Thread Fittings**. Use National Pipe Taper (NPT) threads and protect male threaded ends in shipment using plastic coatings or other equally satisfactory means.

2.8.6.5. **Compression Tube Fittings**. Provide with a Buna-N beveled gasket.

Brass fittings require the following testing.

- Submerge in water for 10 sec. at 85 psi with stops in closed and open positions.
- Reject any fittings that show air leakage. The Department may confirm tests locally. An entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

2.9. **Gate Valves, Tapping Valves, and Tapping Sleeves**.

2.9.1. **Gate Valves**. Use gate valves conforming to AWWA C 500, C 509, and C 515, and the following supplemental Specifications.

Provide direct-bury valves and valves in subsurface vaults that open clockwise. Prove aboveground valves that open counterclockwise.

If the type of valve is not indicated on the plans, use gate valves as line valves for sizes less than 20 in. If the type of valve is specified, no substitute is allowed.

Use a valve body of straight-through or angled, meter-stop design equipped with the following.

- **O-Ring Seal**. Straight plug type.
- **Rubber Seat**. Ball type.

Provide the outlet end with female iron-pipe threads or swivel-nut meter-spud threads on 3/4-in. and 1-in. stops, and with a two-hole flange on 1-1/2 in. and 2-in. sizes.

Where installing at depths greater than 4 ft., provide gate valves with a nonrising extension stem with a coupling able to attach securely to the operating nut of the valve. Terminate the upper end of the extension stem in a square wrench nut no deeper than 4 ft. from the finished grade. Support the extension stem with an arm attached to the wall of the manhole or structure that loosely holds the extension stem and allows rotation in the axial direction only.

Provide gate valves in factory-mutual type meter installations conforming to this Specification, with outside screw and yoke valves, and carrying the UL label.

Provide coatings in accordance with AWWA C 550, Indurall 3300 or approved equal, that are nontoxic; do not impart taste to water; function as a physical, chemical, and electrical barrier between the metal base and surroundings; and are a minimum 12-mil thick fusion-bonded epoxy. Before assembling the valve, apply the protective coating to the interior and exterior surfaces of the body.

Provide flange joints when the valve is connected to steel pipe.

Mount valves horizontally if the proper ground clearance cannot be achieved by a normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear that is mounted vertically, for aboveground operation.

2.9.1.1. **Gate Valves 1-1/2 in. in Diameter and Smaller**. Use an operating pressure of 125 psi, bronze mounting, rising stem, single wedge, disc type, screwed ends, Crane No. 428 or approved equal.

2.9.1.2. **Gate Valves 2 in. in Diameter**. Use an iron body, double-gate, nonrising stem, 150-lb. test, 2-in. square nut operating clockwise to open.

2.9.1.3. **Gate Valves 4 in.–12 in. in Diameter**. Nondirectional; standard wall resilient-seated in accordance with AWWA C 509, parallel seat double-disc in accordance with AWWA C 500, or reduced wall resilient-seated gate valves AWWA C 515; operating pressure of 200 psi; bronze mounting; push-on bell ends with rubber joint rings and nut-operated unless otherwise specified; resilient-seated provided by American Darling AFC-500, US Pipe Metro Seal 200, or approved equal; reduced wall resilient-seated valves by American Flow Control Series 2500 or approved equal; double-disc provided by American Darling 52, Clow F-6102, or approved equal; and in compliance with the following unless otherwise shown on the plans.

2.9.1.3.1. **Design**. Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless steel fasteners or screws. Threaded connection isolated from water by compressed rubber around opening.

2.9.1.3.2. **Body**. Cast or ductile iron. Flange bonnet and stuffing box together with ASTM A307, Grade B, bolts. Cast the manufacturer's initials, pressure rating, and year manufactured into the valve body.

2.9.1.3.3. **Bronze**. Ensure that the valve components in the waterway contain at most 15% zinc and at most 2% aluminum.

2.9.1.3.4. **Stems**. ASTM B763 bronze, Alloy No. 995; minimum yield strength of 40,000 psi; minimum elongation in 2 in. of 12%; and nonrising.

2.9.1.3.5. **O-Rings**. For AWWA C 509, Section 2.2.6 and Section 4.8.2. For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.

2.9.1.3.6. **Stem Seals**. Consist of three O-rings, two above and one below the thrust collar, with an antifriction washer located above the thrust collar.

2.9.1.3.7. **Stem Nut**. Independent or integrally cast of ASTM B62 bronze.

2.9.1.3.8. **Resilient Wedge**. Molded; synthetic rubber; vulcanized and bonded to cast iron or ductile iron wedge tested to meet or exceed ASTM D429, Method B, or attached with 304 stainless steel screws; and seat against epoxy-coated surface in the valve body.

2.9.1.3.9. **Bolts**. Furnish in accordance with AWWA C 509, Section 2.2.5; AWWA C 500, Section 3.4; or AWWA C 515, Section 4.4.4, and stainless steel, cadmium-plated, or zinc-coated.

2.9.1.4. **Gate Valves 14 in. and Larger in Diameter**. AWWA C 500, parallel seat double-disc, or AWWA C 515; reduced wall, resilient-seated gate valves; flanged ends; and nut-operated unless otherwise specified. Provide reduced wall resilient-seated valves with 250-psig pressure rating and manufactured by American Flow Control Series 2500 or approved equal. Provide double-disc valves with 150-psig pressure rating and manufactured by American Darling 52, Clow F-6102, or approved equal. Comply with following requirements unless otherwise shown on the plans.

2.9.1.4.1. **Body**. Cast iron or ductile iron. Flange together bonnet and stuffing box with ASTM A307, Grade B, bolts. Cast the following into the valve body: manufacturer's initials, pressure rating, and year manufactured. When mounting horizontally, equip valves greater in diameter than 12 in. with rollers, tracks, and scrapers.

2.9.1.4.2. **O-Rings**. For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.

2.9.1.4.3. **Stems**. ASTM B763 bronze, Alloy No. 995; minimum yield strength of 40,000 psi; minimum elongation in 2 in. of 12%; and nonrising.

2.9.1.4.4. **Stem Nuts**. Machined from ASTM B62 bronze rod with integral forged thrust collar machined to size, nonrising.

2.9.1.4.5. **Stem Seals**. Consisting of three O-rings, two above and one below the thrust collar, with an antifriction washer located above the thrust collar for operating torque.

2.9.1.4.6. **Bolts**. AWWA C 500, Section 3.4, or AWWA C 515, Section 4.4.4, and stainless steel cadmium-plated or zinc-coated.

2.9.1.4.7. **Discs**. Cast iron with bronze disc rings securely pinned into machined dovetailed grooves.

2.9.1.4.8. **Wedging Device**. Solid bronze or cast iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast iron surfaces are acceptable. Provide other moving surfaces integral to wedging action that are bronze Monel or nickel alloy-to-iron.

2.9.1.4.9. **Gear Cases**. Cast iron; furnished on 18-in. and larger valves and of extended type with steel side plates; lubricated; and gear case enclosed with oil seal or O-rings at shaft openings.

2.9.1.4.10. **Bronze Mounting**. Built as integral unit mounted over, or supported on, cast iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.

2.9.1.4.11. **Stuffing Boxes**. Located on the top of the bonnet and outside the gear case.

Provide a bypass for double-disc gate valves 24 in. and larger.

2.9.1.5. **Gate Valves 14 in.–36 in. in Diameter**. Provide AWWA C 515, reduced wall, resilient-seated gate valves with 250-psi pressure rating. Furnish with spur or bevel gearings.

Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for aboveground operation.

Use valve body, bonnet, wedge, and operator nut constructed of ductile iron.

Fully encapsulate the exterior of the ductile iron wedge with rubber. Ensure the wedge is symmetrical and seals equally well with flow in either direction.

Provide bolts AWWA C 515, Section 4.4.4, stainless steel, and cadmium-plated or zinc-coated.

Provide high-strength bronze stem and nut.

Provide AWWA C 515, Section 4.2.2.5, pressure O-rings as gaskets. Provide stem sealed by three O-rings. The top two O-rings must be replaceable with the valve fully open at the full-rated working pressure. Provide thrust washers for the thrust collar for easy valve operation.

2.9.2. **Tapping Valves**. Provide double-disc or resilient-wedge type tapping valves meeting the requirements of gate valves, as listed in Section 2.9.1.5., "Gate Valves 14 in.–36 in. in Diameter," except for the type of joints, and inlet flanges meeting AWWA C 110, Class 125, or meeting AWWA C 110, Class 150, or higher, and with a minimum eight-hole flange. Provide outlets with standard mechanical or push-on type joints that fit any standard tapping machine.

Provide a valve seat opening such that a full-size shell cutter for the nominal size tap may pass through the valve without any contact with the valve body.

Provide valve boxes conforming to Section 2.11., "Valve Boxes."

2.9.3. **Tapping Sleeves**. Provide tapping sleeve bodies in accordance with AWWA C 110 ductile iron, or AWWA C 111 carbon steel, in two sections bolted together with high-strength, corrosion-resistant, low-alloy steel bolts, and with mechanical joint ends.

Provide flanged branch outlets of tapping sleeves, machine-recessed in accordance with AWWA C 207, Class D, ANSI 150-lb. drilling. Ensure the gasket is affixed around the recess of the tap opening to preclude rolling or binding during installation.

Provide tapping sleeves with a 3/4-in. NPT test opening for testing before tapping. Provide a 3/4-in. bronze plug for the opening.

2.9.3.1. **Steel Sleeves**. Do not use steel sleeves for taps greater than 75% of the pipe diameter.

Use steel sleeves only on pipe diameters 6 in. and larger. No size-on-size sleeve is permitted (e.g., 6 in. × 6 in.). To accomplish size-on-size connections, the next smaller tap may be made and a large end bell (LEB) increaser used. Where fire service from a 6-in. main is approved, only a ductile iron split sleeve is permitted.

Provide a body of heavy-welded steel construction. Groove the top half of the body to permanently retain a neoprene O-ring seal against the OD of the pipe.

Provide fusion-bonded steel sleeves, epoxy-coated to a minimum 12-mil thickness. Ensure the finished epoxy coat is free of laminations and blisters, does not peel, and remains pliant and resistant to impact. Ship steel sleeves in wooden crates that protect the epoxy coating during transport and storage.

Use bolts and nuts conforming to AWWA C 500, Section 3.5, and coated with a 100% vinyl resin (or made of corrosion-resistant material).

For steel tapping sleeves, use Smith Blair No. 622, Rockwell No. 623, JCM No. 412, or approved equal.

2.9.4. **Air Release and Vacuum Relief Valves**.

2.9.4.1. **Combination Air Valves**. Provide where combination air valves are designed to fulfill the functions of air release, permitting the air accumulated in the line at the high point of elevation to escape while the line is under pressure, and vacuum relief. For valve exterior, paint with shop-applied primer suitable for contact with potable water. Provide Apco Model 145C or Model 147C, Val-matic Series 200, or approved equal valves as shown on the plans.

2.9.4.2. **Air Release Valves**. Provide with flanged inlet and outlet connections as specified on the plans. For 2-in. and 3-in. single-body valves, size the orifice for a 100-psi working pressure. Fabricate the air relief valve of materials as follows: body and cover, ASTM A48, Class 30, cast iron; float and leverage mechanism, ASTM A240 or ASTM A276 stainless steel; and orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt. Other valve internals must be stainless steel or bronze.

2.9.4.3. **Air Release and Vacuum Valves**. Provide single-body standard combination or duplex-body custom combination valves as shown on the plans.

2.9.4.3.1. **2-in. and 3-in. Single-Body Valves**. Provide inlet and outlet sizes as shown on the plans and an orifice sized for a 100-psi working pressure. Valve material Specifications are as follows.

- **Body, Cover, and Baffle**. ASTM A48, Class 35, or ASTM A126, Grade B, cast iron.
- **Plug or Poppet**. ASTM A276 stainless steel.
- **Float**. ASTM A240 stainless steel.
- **Seat**. Buna-N.
- **Other Valve Internals**. Stainless steel.

Paint valve exterior with an epoxy shop-applied primer. Provide Apco Model 145C or Model 147C, Val-Matic Series 200, or approved equal.

2.9.4.3.2. **3-in. and Larger Duplex-Body Valves**. As shown on the plans, provide an Apco Series 1700 with a No. 200 air release valve, GA Industries Fig. No. AR/GH-21K/280, or approved equal.

Air and vacuum valve material Specifications are as follows.

- **Body and Cover**. ASTM A48, Class 35, cast iron.
- **Float**. ASTM A240 stainless steel.
- **Seat**. Type 304 stainless steel and Buna-N.
- **Other Valve Internals**. Stainless steel or bronze.

Construct air release valve as specified in Section 2.9.4.2., “Air Release Valves.”

2.9.5. **External Coating Aboveground Valves**. Coat valves with a polyurethane coating conforming to Section 2.2.7.3.2.2., “Polyurethane Coating.”

2.10. **Butterfly Valves**. Provide butterfly valves and operators conforming to AWWA C 504, Class 150B, except as modified or supplemented in this Specification. Provide short-body valves with a flanged design for closing against a flow velocity of 16 ft. per second at a normal working pressure of 150 psi and with a downstream pressure of 0 psi (Class 150B).

Provide direct-bury valves and valves in subsurface vaults that open clockwise. Provide aboveground and plant valves that open counterclockwise.

Body must be cast iron, ASTM 126, Class B.

Discs for butterfly valves must be cast iron or ductile iron.

Provide valves with Buna-N or neoprene seats mounted either on the disc or in the body. Mechanically secure the seats, not relying solely on adhesive properties of epoxy or similar bonding agents to attach the seats to the body. Mechanically retain the seats on the disc using stainless steel (18-8) retaining rings held in place by stainless steel (18-8) cap screws that pass through a rubber seat for added retention. When the seat is on the disc, retain the seat in position using shoulders located on the disc and the stainless steel retaining ring. Provide mating surfaces for seats of Type 304 or Type 316 stainless steel, secured to the disc by mechanical means. Sprayed-on or plated mating surfaces are not allowed. Provide a cast iron disc conforming to ASTM A126, Class B, or ductile iron conforming to AWWA C 151. The seat must be replaceable in the field for valves greater than 30 in. in diameter. Valves with segmented retaining rings are not acceptable.

Coat interior wetted ferrous surfaces of the valve, including the disc, with epoxy suitable for potable water conditions. Furnish epoxy, perform surface preparation, and apply epoxy in accordance with AWWA C 550 and the coating manufacturer’s recommendations. Provide three coats of two-component, high-build epoxy

with a minimum dry thickness of 12 mils. Use Indurall 3300, or approved equal, epoxy coating. Holiday-test and measure the coatings for thickness.

Use Type 304 or Type 316 stainless steel for the valve shaft and keys, 24 in. in diameter and greater, that require at least 2 in., or taper pins used for attaching the valve shaft to the valve disc. Do not use a torque plug to attach the valve shaft to the valve disc. All portions of shaft bearings must be stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with a proven record of preventing Teflon flow under load) in accordance with AWWA C 504, stainless steel bearing material. Design the valve shaft to withstand three times the amount of torque necessary to the open the valve.

Packing must be field-adjustable, split-V type, and replaceable without removing the operator assembly.

Retaining hardware for seats must be Type 304 or Type 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats must be securely held using locktight or other approved method to prevent loosening by vibration or cavitational effects.

Seat the valve disc in a position 90° to the pipe axis and ensure it rotates 90° between the fully opened and tightly closed position. Install valves with valve shafts horizontal and the convex side of the disc facing the anticipated direction of flow, except where shown otherwise on the plans.

Use push-on or flanged (flanged valves coupled to Bell-Flange adapters may be used) joint types for installation with cast iron pipe or DIP. Use flanges conforming in dimensions and drilling to ANSI B 16.1 for cast iron body valves, Class 125. Use bolts conforming to AWWA C 500, Section 9, in valve installations, including bolts for operators and housing. Use flanged joints for steel or concrete steel cylinder pipes.

Provide properly sized gear-type actuators for valves 8 in. and larger. Provide fully enclosed and traveling-nut type, rack-and-pinion type, or worm-gear type gear actuators. Equip direct-bury valves with a 2-in. square nut operating clockwise to open the valve. Completely enclose the space between the actuator housing and the valve body. Ensure that no moving parts are exposed to the soil or elements. Provide oiltight and watertight actuators, factory-packed with suitable grease. Use operators conforming to AWWA C 504 and equipped with adjustable limit stop devices.

Design worm-gear and traveling-nut operators so a torque of 150 foot-pound (ft.-lb.) or less will operate the valve at the most adverse condition for which the valve is designed. Ensure the vertical axis of the operating nut does not move as the valve is opened or closed.

If the type of valve is not indicated on the plans, use butterfly valves for line valve sizes 24 in. and larger. For valves 24 in. and larger, provide valves manufactured by Pratt, Dezurik, or approved equal. Provide valves from an approved manufacturer. Provide valves and actuators from the same valve or actuator manufacturer. Ensure the shaft connecting the actuator to the valve body is fully enclosed. Provide a fully enclosed, watertight bonnet and extension.

2.11. **Valve Boxes**. Provide Type A cast iron or ductile iron slide-type valve boxes as manufactured by Bass and Hays Foundry, Inc., or approved equal. Ensure the chemical composition of Casting A conforms to AWWA C 110. Fabricate the base of each valve box from 6-in. cast iron pipe or DIP conforming to this Specification, except that the lining and coating must comply with this Section.

Cast a letter “W” into the lid, 1/2 in. in height and raised 3/32 in., for valves serving potable water lines.

Coat boxes, bases, and lids by dipping them in hot bituminous varnish.

2.12. **Fire Hydrants**.

2.12.1. **General**. Provide fire hydrants, including 6-in. gate valve and box, conforming to AWWA C 502, except as modified or supplemented in this Specification, and that are on the utility owner’s approved products list.

Provide fire hydrants in conformance with AWWA C 502, "Standards for Dry Barrel Fire Hydrants." Provide hydrants that are approved by the City of Houston. Only hydrants with a current certification of responsibility are allowed. The hydrants shown in Table 4 are approved. Alternative hydrants will not be considered.

Table 4
Approved Hydrants

Hydrant	City of Houston Engineering Control Drawing
U.S. Pipe and Foundry Con. M-94 Metropolitan 5-1/4 in. A495	DWG 960324 Rev. dated February 6, 2002
Mueller Company Super Construction 250 5-1/4 in. A423	DWG FH-70 Rev. B dated July 2, 2008
American AVK Company AVK Series 2780 Nostalgic	DWG 2780-Houston-2Rev. AAD3 dated March 24, 2004

Ensure they are of dry-barrel, tamper-resistant, and collision-safety construction design. Provide hydrants from same manufacturer throughout the project.

Installation of used, salvaged, or reconditioned fire hydrants is not permitted.

2.12.2. **Hydrant Barrel**. Fabricate the lower hydrant barrel as a ductile iron single piece and connect it to the upper hydrant barrel by joint coupling that provides a 360° rotation of the upper barrel. Clearly mark the finish grade on the barrel. Provide the specified bury length, equal to the distance from the bottom of the inlet to the ground line.

Provide the hydrant barrel with a non-tapped, non-corrodible drain or drip valve, completely made of bronze or bronze-lined. Ensure the drain valve operates, automatically and positively, to drain the barrel when the hydrant valve is in the fully closed position, and to completely close the drain opening to prevent leaking when the hydrant valve is in the open position.

Equip each hydrant barrel with two 2-1/2 in. nominal ID hose nozzles and a single 4-in. nominal ID pumper nozzle conforming to National (American) Standard Fire Hose Coupling Screw Threads, bronze (minimum Grade D) (per NFPA No. 194 and ANSI B 26-1925).

Security-fasten field-replaceable nozzles into the upper barrel by mechanical means, install by turning counterclockwise, seal with O-rings, and mechanically lock in place with a security device. Provide nozzles with nozzle caps and neoprene gasket seals. Securely attach the caps to the hydrant barrel with chains of no less than 1/8-in. diameter. Situate the pumper nozzle to allow an unobstructed radius of 10 in. from the threaded surface of the nozzle throughout the path of travel of a wrench or other device used to fasten a hose to the nozzle.

Orient the hydrant so that the pumper nozzle faces the curb or street closest to the hydrant.

Design the barrel joint connecting the upper and lower hydrant sections so that the hydrant shutoff valve will remain closed and tight against leakage in the event of an impact accident resulting in damage to or breaking of the hydrant above or near ground level. Provide the joint with a breakable bolt flange or breakable coupling, including an adequate number of bolts, above finish grade.

Fabricate the operating and hold-down nuts of stainless steel, cast iron, or ductile iron with bronze inserts. Provide a security device with each hydrant employing a bronze operating nut to protect this feature of the hydrant from malicious mischief or unauthorized removal. Ensure that such security devices do not require special tools for normal off-on operation of the hydrant. For the operating nut, use a tapered pentagon with 1-1/2 in. point to face at the base, and 1-1/8 in. point to face at the top of the nut, opening left (counterclockwise). Fabricate hold-down assemblies of metallic materials suitable for the intended service.

Design the hydrant barrel to permit the use of one or more standard extensions, available from the hydrant manufacturer, in lengths from 6 in.–60 in. in 6-in. increments.

2.12.3. **Shutoff Valve and Inlet Shoe**. Provide hydrants with circular, compression-type shutoff valves that close with the water pressure, with center stem construction, and that remain closed and tight against leakage upon impact. Ensure each shutoff valve is circular and no less than 5-1/4 in. in diameter. Seal the bottom end of the stem threads from contact with water using a cap nut. Provide a bronze valve seat ring, threaded into a bronze drain ring, to provide an all-bronze drainway. Ensure the seat ring and main valve assembly are removable from above ground through the upper barrel using a lightweight seat removal wrench.

Construct the valve seat facing of molded rubber with a durometer rating of 90 ±5, with a minimum thickness of 1/2 in., and that is resistant to microbiological attack.

Unless otherwise shown on the plans, provide a hydrant inlet shoe that is an elbow with the AWWA standard bell designed for a nominal 6-in. mechanical joint hub end, or push-on assembly, as specified. Provide a hydrant shoe of cast iron pipe or DIP that is flanged, swivel, or slip joint with harnessing lugs for restrained joints. Coat the interior of the shoe with at least 12 mils of fusion-bonded epoxy conforming to NSF 61. For underground flanging, incorporate at least six 3/4-in. diameter electro-galvanized or cadmium-coated steel bolts or four 5/8-in. diameter stainless or cadmium-coated steel bolts.

2.12.4. **Valve Stem**. Where threads are in the barrel or waterway, use Everdure operating stems, or other high-quality, non-correctible metal.

Use bronze-to-bronze working parts in the waterway and genuine wrought iron or steel where threads are not located in the barrel or waterway, bronze-bushed at the penetration of the stuffing box. Seal the threads against contact with water regardless of the position (open or closed) of the main valve. Provide the valve stem with a breakable stem coupling opposite the barrel breakaway feature. Construct connecting pins and locking devices of bronze or other corrosion-resistant material. Provide the valve stem with a bronze sleeve, O-ring seals, and a travel stop. Ensure the operating threads, working parts, and bearing surfaces are fully lubricated during normal operation of the fire hydrant. Ensure the lubricant is contained in a lubricating reservoir that is sealed at the top and bottom. Equip the operating assembly with a thrust bearing or lubricated thrust collar to minimize operating torque. Provide a lubricant meeting Food and Drug Administration (FDA) 21 CFR § 178.3570 and manufactured with FDA-approved oxidation inhibitors.

Provide a valve stem that operates counterclockwise (turning to the left) to open.

2.12.5. **Gaskets and Seals**. Provide dynamic seals of O-ring type, oil-resistant material, that do not require adjustment for a watertight seal. Provide moving parts in contact with the seal made of bronze or other corrosion-resistant material.

Provide static seals of Buna-N or other approved synthetic composition.

2.12.6. **Painting**. Shop-coat the fire hydrant's exterior with one coat of rust-prohibitive primer. Ensure the top half of the hydrant from the traffic flange up receives one coat of blue enamel before delivery to the jobsite as outlined by the following.

2.12.6.1. **Exterior Above Traffic Flange (Including Bolts and Nuts)**. Prepare the surface in accordance with SSPC-SP 10 (NACE 2), near-white blast-cleaned surface.

Coat with a three-coat alkyd-silicone-alkyd system with a total DFT of 6 mils–9 mils as follows.

- **Prime Coat**. Oil Modified Alkyd Primer, Acro Products No. 1104, Heavy Duty Tank & Steel Primer, or approved equal, in general accordance with SSPC Paint Specification No. 25. Apply with a total DFT of 2 mils–3 mils.
- **Intermediate Coat**. Heavy Duty Industrial Alkyd Enamel, Acro Products No. 2214, or approved equal, in general accordance with SSPC Paint Specification No. 104, and Federal Standard TT-E-489. Apply with a total DFT of 2 mils–3 mils.

- **Finish Coat**. Silicone Alkyd Resin Enamel, Acro Products No. 2215, or approved equal, in general accordance with SSPC Paint Specification No. 21. Total DFT of 2 mils–3 mils, but do not finish-shop coat the hydrant bonnet, only intermediate-coat it. Field-apply and color-code the finish coating when installed.
- **Colors**. For primer, use the manufacturer's standard color. For the finish coat of the hydrant body, use blue (Acro 555 crystal blue or equivalent). Finish-coat the hose connection caps white, and paint a white band of finish coat 2 in. in width on the hydrant body approximately 6 in. above and parallel to the traffic flange. For intermediate coat, use a contrasting color to the blue finish coat, such as white.

2.12.6.2. **Exterior Below Traffic Flange**. Prepare the surface in accordance with SSPC-SP 10 (NACE 2), near-white blast-cleaned surface.

Coat with a three-coat system as follows.

- **Primer and Intermediate Coat**. Coal-tar epoxy, Acro Products No. 4467, or approved equal, in general accordance with SSPC Paint Specification No. 16. Apply two coats with a DFT of 8 mils–10 mils each, for a total DFT of 16 mils–20 mils.
- **Finish Coat**. Water-based vinyl acrylic mastic, Acro Products No. 7782, or approved equal. Apply one coat with a DFT of 6 mils–8 mils. For the color of the finish coat, use the same as for the finish coat for the exterior above the traffic flange (i.e., blue [Acro 555 crystal blue or equivalent]).

2.12.6.3. **Interior Surfaces Above and Below Main Valve**. Provide material used for internal coating of hydrant interior ferrous surfaces below the main valve that is NSF-61 listed as suitable for contact with potable water, as required by TCEQ, Chapter 290, "Rules and Regulation for Public Water Systems."

Prepare the surface in accordance with SSPC-SP 10 (NACE 2), near-white blast-cleaned surface.

Provide a liquid or powder epoxy system coating in accordance with AWWA C 550. Apply the coating in two or three coats, according to the manufacturer's recommendations, for a total DFT of 12 mils–18 mils.

2.12.6.4. **General**. Apply coatings in strict conformance with the manufacturer's recommendation. No requirement of this Specification cancels or supersedes the written directions and recommendations of the specific coating manufacturer to jeopardize the integrity of the applied system.

Ensure the hydrant supplier furnishes an affidavit of compliance that the materials and work furnished comply with this Specification and referenced applicable standards.

After installing the hydrants and before the main is accepted, paint the bonnet portion of each fire hydrant as shown in Table 5.

Table 5
Fire Hydrant Bonnet Colors

Size of Supply Line (in.)	Color of Bonnet
6	Yellow
8	White
10–20	Green
24 and larger	Orange

Ensure the color shades and paint quantities are approved and comply with the Specifications.

2.12.7. **Performance Standards**. Provide hydrants capable of a free discharge of 1,500 gal. per minute (gpm) or greater, from a single pumper nozzle at a hydrant inlet static pressure not exceeding 20 psig as measured at or corrected to the hydrant inlet at its centerline elevation.

Provide hydrants capable of a discharge of 1,500 gpm or greater from a single pumper nozzle at a maximum permissible head loss of 8.0 psig (when corrected for inlet and outlet velocity head) for an inlet operating pressure not exceeding 37 psig as measured at or corrected to the hydrant inlet at its centerline elevation.

2.12.7.1. **Hydraulic Performance Testing**. In accordance with AWWA C 502, ensure the certified pressure loss and quantity of flow test is conducted by a qualified testing laboratory on a production model (5-ft. bury length) of the hydrant (same catalog number) proposed for certification. Submit a certified test report containing the date of test, within the previous 5 yr., on a fire hydrant with similar hydraulic characteristics, and name, catalog number, place of manufacture, and date of production of hydrants tested.

Provide schematic drawing of testing apparatus, containing dimensions of piping elements, including:

- diameter and length of inlet piping;
- distance from flow measuring points to pressure measurement point;
- distance from flow and pressure monitoring points to the hydrant inlet;
- distance from pressure monitoring point to nozzles;
- diameter and length of discharge tubing; and
- elevation of points of measurement, inlet, and outlet.

Provide reports or certificates documenting the accuracy of the measuring devices used in testing.

Conduct the tests on at least three hydrants of the same fabrication design. Inlet water temperature must be 70°F ±5°F.

For traffic impact testing, submit a certified test report outlining the results of the traffic impact test involving standard production models of the fire hydrant with breakable barrels of the same design as that proposed for certification. Install these hydrants per AWWA C 600. Strike at a point 18 in. ±2 in. above the designated ground line. Conduct tests using the point of impact on hydrant barrel within 2 in. of a line perpendicular to base and equidistant from the pumper nozzle and one hose nozzle.

Conduct successive tests simulating impacts by standard American-made vehicles with gross weights of 3,500 lb., 5,500 lb., and 10,500 lb.

Document the tests to provide the following minimum information.

- Detailed schematic drawings of the test facility
- Complete description of the mechanical impact testing equipment used
- Complete list of the hydrant parts and materials damaged in each impact test
- Photographs
- Size and static pressure of the line to which the hydrant is attached
- Estimated amount of water discharged, if any, from the hydrant within 30 min. immediately following the collision

2.12.8. **Hydrant Leads**. Provide hydrant branch leads conforming to the same requirements under Section 2.2.3., “Steel Pipe Fittings”; Section 2.3., “Ductile Iron Pipe (DIP) and Fittings”; or Section 2.4., “Polyvinyl Chloride (PVC) Pipe and Fittings.”

2.13. **Polyethylene Film Wrap**.

2.13.1. **General**. Except where noted on the plans, use polyethylene film as a wrap to protect cast iron pipe, DIP, and fittings. Provide polyethylene film conforming to this Specification and use only in open-cut construction.

2.13.2. **Film**. Provide polyethylene film in accordance with ASTM 1248 and AWWA C 105, Type 1, Class C, Category 5, Grade J-3, 2.5%–3% carbon black content. Unless otherwise shown on the plans, provide film

8 mils thick with a minimum tensile strength of 1,200 psi–2,500 psi, elongation up to 600%, and in either tubular or sheet form. Furnish film supplied in tubular form in the minimum widths shown in Table 6.

Table 6
Minimum Width of Film Tube (When Lying Flat)

Nominal Pipe Size (in.)	Push-On Joint Flat Tube Width (in.)
4	14
6	17
8	21
10	25
12	29
14	33
16	37
18	41
20	45
24	53

For film in sheet form, furnish in widths equal to twice those shown for tubes.

2.13.3. **Polyethylene Tape**. For taping film edges and overlays, use 3-in. wide plastic-backed adhesive tape. Use Polyken No. 900, Scotch Wrap No. 50, or approved equal.

2.14. **Bedding Material**. Unless otherwise shown on the plans, provide one of the following types of bedding for water mains.

2.14.1. **Bank Run Sand**. Furnish bank run sand bedding as called for in these Specifications and consisting of soil classified as SP, SW, or SM by the Unified Soil Classification System (USCS). Provide sand with a plasticity index, when tested, of less than 7% and a liquid limit of 25 or less. Ensure the bank run sand gradation has a maximum 15% passing the No. 200 sieve when tested, and is free of roots, organic material, trash, clay lumps, or other deleterious or objectionable material.

2.14.2. **Concrete Sand**. Furnish concrete sand bedding conforming to the specifications for Fine Aggregates in ASTM C33. Provide Fine Aggregates consisting of natural sand, manufactured sand, or a combination of the two, within the gradation limits shown in Table 7.

Table 7
Fine Aggregate Gradation

Sieve Size	Passing (%)
3/8 in.	100
No. 4	95–100
No. 8	80–100
No. 16	50–85
No. 30	25–60
No. 50	10–30
No. 100	2–10

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps, or other deleterious or other objectionable materials, more than the limits prescribed in ASTM C33.

2.14.3. **Pea Gravel**. Furnish pea gravel bedding conforming to the specifications for Coarse Aggregates specified for No. 8 size in ASTM C33. Provide Coarse Aggregates consisting of gravel comprising small, smooth, rounded stones or pebbles, within the gradation limits shown in Table 8.

Table 8
Coarse Aggregate Gradation

Sieve Size	Passing (%)
1/2 in.	100
3/8 in.	85–100
No. 4	10–30
No. 8	0–10
No. 16	0–5

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps, or other deleterious or other objectionable materials, more than the limits prescribed in ASTM C33.

2.14.4. **Gem Sand**. Furnish gem sand conforming to specifications for Coarse Aggregates specified for No. 8 size in ASTM C33. Specifically, provide aggregates within the gradation limits shown in Table 9.

Table 9
Gem Sand Gradation

Sieve Size	Passing (%)
3/8 in.	95–100
1/4 in.	60–80
No. 4	15–40
No. 10	0–5

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps, or other deleterious or other objectionable materials, more than the limits prescribed in ASTM C33.

2.15. **Backfill Material**. For sand backfill encasement of water mains, use one of the following materials, unless otherwise shown on the plans.

2.15.1. **Cement-Stabilized Sand**. Furnish cement-stabilized backfill containing at least 5% cement per cubic yard of material placed, based on the dry weight of the aggregate in accordance with Tex-120-E. Provide materials consisting of aggregate, cement, and water. Use cement and water conforming to the material requirements of Item 421. Provide sand aggregate, free of deleterious matter, with a plasticity index no greater than 6 when tested by Tex-106-E.

2.15.2. **Earth or Native Soil**. Furnish earth or native soil backfill consisting of soil containing no deleterious material such as trash, wood fragments, or organic or other objectionable material. Supply the material from either the material removed from the excavation or offsite sources.

The material may consist of soil classified by the USCS as ML, CH, CL, CL-ML, SC, SP, SM, SW, or GC. Use earth backfill that meets the compaction requirements in this Specification and does not cause any settlement.

2.15.3. **Bank Run Sand**. Furnish bank run sand backfill as called for in these Specifications and conforming to the same requirements as those under Section 2.14.1., “Bank Run Sand.”

2.16. **Concrete**. Use Class A concrete in conformance with Item 421, unless otherwise shown on the plans. Leave the forms in place unless directed to remove certain sections of the forms.

2.17. **Water Meters, Meter Vaults, and Meter Boxes**.

2.17.1. **Water Meters**. Provide meters of the type and size indicated on the plans.

2.17.1.1. **Bolted Split Casings**. Provide main casings of meters and external fasteners: copper alloy with minimum 75% copper for 5/8 in.–2 in., bronze or cast iron, hot-dip galvanized or epoxy coating for coating for 3 in. and larger.

2.17.1.2. **Straightening Vanes**. Use noncorrosive material compatible with the case material.

2.17.1.3. **Intermediate Gear Train**. Do not allow the intermediate gear train to contact water. Operate in suitable lubricant.

Use automatic meter-reading (AMR) type register that provides pulse, contact closure, piezo switch, or encoder-generated output signal, compatible with utility owner's radio and telephone AMR systems. Provide a minimum 12 ft. of wire when permanently connected to the register. Lens must be impact-resistant. Register box must be tamper-resistant by tamper screw or plug. Register must be permanently sealed, straight-reading, center-sweep test hand, magnetic-driven, reading in U.S. gallons. Six digits are required and must be black, with the lowest registering three digits (below 1,000-gal. registration) in contrasting digit and background colors. Register capacity of meters must be 9.99 million gal. for 5/8 in.–2 in. and 999.999 million gal. for 3 in. and larger.

Connections must be threads at each end for 5/8 in.–1 in., two-bolt oval flanges at each end for 1-1/2 in. to 2 in., and flange at each end for 3 in. and larger.

Stamp the manufacturer's meter serial number on the outer case. Stamp the manufacturer's meter serial number on the outside of the register lid, when provided. Ensure the manufacturer's serial numbers are individual and not duplicated.

Equip compound and turbine meters with AMR-type register to connect to the utility owner's AMR system, manufactured by Badger, Hersey Products, Neptune, Sensus, or approved equal.

Provide fire service meters manufactured by Hersey Products, Neptune, Sensus, or approved equal. Provide displacement meters manufactured by Badger, Neptune, Hersey, Kent, Sensus, or approved equal.

2.17.1.4. **Manufacturing QC**. Permit successful interchangeability from one meter to another of same size, registers, measuring chambers and units, discs or pistons as units, change gears, bolts, nuts, and washers, without affecting the accuracy of the new meters.

2.17.1.5. **Commercial Meter Valves for Meter Installations**. Provide commercial meter valves identical to line valves, but provide them with Class 125 flanges and equip them with hand wheels operating counterclockwise to open.

For pipe and fittings inside the meter box or meter vault, use ductile iron conforming to Section 2.3., "Ductile Iron Pipe (DIP) and Fittings," and as specified on the plans.

2.17.2. **Meter Vaults**.

2.17.2.1. **General**. Furnish meter vaults of precast concrete vault, cast-in-place concrete vault, or solid masonry design, unless a specific type of construction is required on plans. Ensure dimensions and reinforcement comply with the utility owner's standard meter vault drawings for the type and size shown on the plans. Use Class S concrete conforming to Item 421.

2.17.2.2. **Precast Concrete Vaults**. Construct precast concrete vaults as shown on the plans. Use reinforcing steel conforming to Item 440.

Install precast vaults in conformance with the manufacturer recommendations. Set level and on a minimum 3-in. thick bed of sand conforming to Section 2.15., "Backfill Material." Seal lifting holes with cement mortar or nonshrink grout.

2.17.2.3. **Meter Vault Floor Slab**. Slope the floor 1/4 in. per foot toward the sump. Make the sump 12 in. in diameter, or 12 in. square, and 4 in. deep, unless other dimensions are shown on the plans. Install dowels at a maximum 18 in., center-to-center, or install a mortar trench for keying the walls to the floor slab.

2.17.2.4. **Cast-in-Place Concrete Vaults**. Construct cast-in-place concrete vaults as shown on the plans. Use reinforcing steel conforming to Item 440. Key the walls to the floor slab.

2.17.2.5. **Frame and Cover**. Use A-36 welded steel or approved equal. Fabricate the cover plate with a 1/4-in. skid-resistant raised pattern floor plate. Fabricate the meter access door from the same material as the cover plate. Perform welding in accordance with Item 441. Nondestructive testing is not required.

Furnish castings for frames, grates, rings, and covers conforming to ASTM A48, Class 30. Provide locking covers if indicated on the plans. Use castings capable of withstanding the application of an AASHTO HS-20 loading, unless otherwise specified.

Provide covers and frames conforming to the shape dimensions and with the wording or logos shown on the plans. The standard diameter dimension for manhole covers is 32 in. Furnish frames, grates, rings, and covers conforming to Item 471, but as noted above and except for measurement and payment.

2.17.3. **Meter Boxes**.

2.17.3.1. **General**. Furnish meter boxes for 5/8-in.–1-in. meters of the following materials.

- **Nontraffic-Bearing Locations**. Cast iron, concrete, or plastic as specified on the plans.
- **Traffic-Bearing Locations**. Cast iron.

Meter boxes for 1-1/2 in. and 2-in. meters must be cast iron. Provide meter box lids with a key-operated, spring-type locking device and a reading lid. Ensure the lids contain enough metals so that the meter box is easily located with a metal detector. If words are specified on the plans, cast them into lid with letters 1/2 in. high and raised 3/32 in. Ensure the size reads 5/8 in.–1 in. or 1-1/2 in.–2 in.

Furnish meter boxes conforming to the following approximate dimensions.

- **Length**. At the top 15-1/2 in. and at the bottom 20 in.
- **Width**. At the top 12-1/2 in. and at the bottom 14-3/4 in.
- **Height**. 12 in.

Ensure that meter box extensions 3 in. and 6 in. in height are available from the manufacturer.

2.17.3.2. **Cast Iron Meter Boxes**. Furnish cast iron boxes that are clean and free of sand blowholes or other defects and that conform to ASTM A48. Machine the bearing surfaces so that the covers seat evenly in the frames. Provide boxes and lids with a dipped, coal-tar pitch, varnish finish. Provide lock-type meter boxes when shown on the plans. Ensure the lock mechanisms work with ease.

2.17.3.3. **Concrete Meter Boxes**. Furnish concrete meter boxes made of Class A concrete conforming to Item 421. Construct boxes as shown on the plans. Furnish castings that are free of fractures, large or deep cracks, blisters or surface roughness, or any other defects that may affect serviceability.

2.17.3.4. **Plastic Meter Boxes**. Furnish plastic meter boxes made of high-density polyethylene conforming to the ASTM specifications shown in Table 10.

Table 10
ASTM Test Requirements for Plastic Meter Boxes

Test	Requirement
D256	Impact Strength = 1.9 ft.-lb./in. (Izod, Notched)
D256	Impact Strength = 6.4 ft.-lb./in. (Izod, Un-Notched)
D638	Tensile Strength (2.0 Min) = 3,400 psi
D648	Deflection Temperature = 170°F
D790	Flexural Modulus = 90,000 psi
D2240	Shore D Hardness, 55–65 Impact Strength, Falling Dart Method, 100 in.-lb.

Provide meter boxes meeting the following test requirements.

- **Static Load**. No less than 2,500 lb. using a 6-in. disc with direct compression exerted at the center of the top of the meter box with a solid plastic lid.
- **Deflection**. No less than 1,000-lb. load required to deflect the top edge of the meter ox 1/8 in.

Provide a meter box body, without lid, weighing approximately 7 lb.

2.18. **Affidavit of Compliance**. Unless otherwise directed, furnish a manufacturer's affidavit of compliance for each of the materials used in this project. Ensure the affidavit certifies that factory inspection and specified tests were performed and that the material furnished complies with this Specification.

2.19. **Pressure-Reducing Station**. Unless otherwise shown on the plans, furnish new and unused station piping, valves, and fittings, of the same type as specified on the plans.

Use Class S concrete in conformance with Item 421.

Provide reinforcing steel in conformance with Item 440.

Provide a pressure-reducing valve (PRV) with a strainer, in the location and arrangement shown on the plans. Provide a valve body made of ductile iron with ANSI B 16.1, Class 150, flanges. Provide a valve cover made of ASTM A48 cast iron. Use Buna-N rubber parts. No leather parts are allowed. Provide a resilient seat with a rectangular cross-section.

Provide a single moving disc and diaphragm assembly for valve internals. Use a flexible nylon fabric-reinforced elastomer diaphragm integral with assembly. Provide valve internal trim (seat ring, disc guide, and cover bearing) made of stainless steel. Apply a heat-fusion bonded epoxy coating to the internal and external surfaces of the valve body, including the disc retainer and diaphragm washer. Holiday-test the coating applied to the valve body to confirm a minimum even coating of 5 mils–7 mils. Treat the stem using a penetrative salt nitride process. Use a Xylan-coated seat. Leather parts are not allowed. Prepare threaded connections by first using an approved pipe tape.

Furnish control tubing containing shutoff cocks with a "Y" strainer. Equip the valve to allow installing control tubing on either side of the valve. Equip the valve with a valve position indicator.

Ensure the valve and valve box are initially set in the field by an authorized manufacturer's representative. Set the downstream pressure at 60 psi unless otherwise specified. Ensure the PRV includes an adjustable and pressure-sustaining pilot system. Use a diaphragm-type or piston-type valve for the main valve.

Provide Cla-Val Model 90-01BDSYKCKD, Watts ACV Model 115-3M, or approved equal.

Provide a basket strainer upstream of the PRV as shown on the plans. Furnish a quick-opening type strainer body of fabricated steel construction with ANSI, Class 150, flanges. Use Type 304 stainless steel for the basket.

Provide a Hayward Model 90, or equal, for PRVs 4 in.–24 in. When there are space constraints, provide a Hayward Model 510, or equal, for PRVs 14 in. or greater.

2.20. **Adjusting Manholes**. Reuse removed manhole and inlet rings, plates, grates, covers, and brick if they are in good condition as determined by the Engineer. Provide additional materials in accordance with Item 465 at no cost to the Department. Single- or multiple-piece prefabricated metal extension rings may be used for the adjustment of manholes as approved. Provide concrete that conforms to Item 421.

3. CONSTRUCTION

All construction must conform to this Special Specification, the plans, and the following Items.

- Item 100, “Preparing Right of Way”
- Item 400, “Excavation and Backfill for Structures”
- Item 402, “Trench Excavation Protection”
- Item 403, “Temporary Special Shoring”
- Item 421, “Hydraulic Cement Concrete”
- Item 465, “Junction Boxes, Manholes, and Inlets”
- Item 476, “Jacking, Boring, or Tunneling Pipe or Box”
- Item 479, “Adjusting Manholes and Inlets”

3.1. **Excavation**.

3.1.1. **Trenches**. Construct water lines and fire hydrant branches (leads) in open-cut trenches with vertical sides, except in those locations where the pipe is tunneled, cased, or augered. Construct the trenches to the dimensions shown in the excavation and backfill details.

Sheath and brace the trenches to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period. Protect excavation greater than 5 ft. in depth as specified by Item 402 or Item 403.

Open and excavate the trenches to the finished grade. To allow for adjustment of the alignment and grade, locate the water mains to which the mains and fire hydrant branches (leads) under construction will be connected, well in advance of making connections.

Construct water mains and fire hydrant branches (leads) in dry trenches. If necessary, employ well pointing or additional sheathing to accomplish this objective, at no additional cost to the Department.

For pipes less than 18 in. in diameter, the minimum trench width below the top of the pipe is the OD of the pipe plus 18 in. For pipes 18 in. and larger, the minimum trench width below the top of pipe is the OD of pipe plus 24 in. Additional width is required for unstable conditions. The Engineer will determine unstable conditions.

Where it is necessary to excavate trenches adjacent to improved property, take precautions to avoid damaging or impairing that property. Where it is necessary to disturb property features such as grass, shrubs, and driveways, restore such improvements to their original condition.

Use enough trench width or benches above the embedment zone when installing well point headers or manifolds and pumps, where the trench depth makes it uneconomical or impractical to pump from the surface elevation. Provide enough space between the shoring cross-braces to permit equipment operations and handling the forms, pipe, embedment and backfill, and other materials.

Before moving the supports, place and compact the embedment to enough depth to provide protection of the pipe and stability of the trench walls. As the supports are moved, finish placing and compacted the embedment.

Immediately before placing the embedment materials, ensure the bottoms and sidewalls of trenches are free of loose, sloughing, caving, or otherwise unsuitable soil.

Place and compact the embedment materials directly against the undisturbed soils in the trench sidewalls or against sheeting that will remain in place.

Do not place trench shields or shoring within the height of the embedment zone unless using some means to maintain the density of the compacted embedment material. If using moveable supports in embedment zone, lift the supports incrementally to allow placing and compacting of the material against undisturbed soil.

Place haunching material around the pipe and compact it to provide uniform bearing and side support.

Place trench dams in Class I embedments near the midpoint of line segments longer than 100 ft. between manholes.

Where damage to the completed pipe installation work is likely to result from withdrawal of the sheeting, leave the sheeting in place.

3.1.2. **Existing Streets**. Unless otherwise shown on the plans, open-cut existing streets.

Where water line construction requires cutting through existing streets outside the limits of new street construction, replace those streets in kind in conformance with the appropriate Specifications in the proposal or as directed. When cutting pavement outside the Department's right of way, comply with the utility owner street-cutting ordinance.

Where in the opinion of the Engineer it is necessary to maintain traffic across a trench, construct temporary bridges as necessary to facilitate the movement of traffic.

At locations where the proposed water main parallels the edge of an existing permanent pavement (e.g., concrete pavement and concrete base with asphalt surface) and is 3 ft. or less from the edge of that pavement, protect the trench with timber sheathing and bracing. Leave the bracing in place at intervals of 5 ft. maximum.

Keep the street surface adjacent to the trench free of surplus spoil. Place construction materials at locations that minimize interference with the traveling public.

Do not close more than two street intersections at any one time unless authorized in writing.

3.2. **Jacking, Tunneling, Boring, or Augering**.

3.2.1. **General**. Perform jacking, tunneling, or augering for water mains and fire hydrant branches (leads) at the locations shown on the plans and at other locations specifically designated by the Engineer.

Unless otherwise shown on the plans, use casing pipe conforming to Section 2.2.2., "Steel Casing Pipe."

Excavate auger pits to a finished grade at least 6 in. lower than that indicated by the construction stakes or as approved, to ensure that a dry pit bottom is encountered.

Provide a minimum width of jacking, tunneling, or augering pits such that there is at least 6 in. of space between the pipe and the walls of the auger pit. The maximum allowable width of the pit is 5 ft., unless otherwise approved. Ensure the width of the pit at the surface is not less than at the bottom. The maximum allowable length of the pit is 5 ft. longer than one full joint of pipe of the type being used and does not exceed 25 ft., unless approved.

Grout in place tunnels for water lines with 36-in. diameters. When casing size is 48 in. in diameter or greater, or when using a tunnel liner plate, regardless of the water line diameter, grout in place unless otherwise directed. Provide an annular grout consisting of a sand-cement mortar mix with a 28-day compressive strength of at least 1,500 psi, when tested in accordance with ASTM C942. The maximum allowable density is 130 pcf.

Use admixtures meeting ASTM C494 and ASTM C1017 as required, to improve pump ability, control the time of set, hold sand in suspension, and reduce segregation and bleeding. Fill the annular space in three lifts to prevent pipe floating. In addition, place appropriate blocking between the carrier pipe and the top of the liner to maintain position. Place a concrete invert to facilitate threading the carrier pipe.

Do not allow inadvertent metallic contact between the casing and the carrier pipe. Place spacers to ensure that the carrier pipe is adequately supported throughout its length, particularly at ends, to offset setting and possible electrical shorting, unless otherwise approved. Ensure the end spacer is within 6 in. of the end of the casing pipe, regardless of the size of the casing and carrier pipe or the type of spacer used. Casing spacers are designed to withstand much greater loads than can be safely applied to most coatings. Therefore, the spacing between spacers depends largely on the load-bearing capabilities of the pipe coating and the flexibility of the pipe.

Install casing spacers in conformance with the manufacturer's instructions. Use particular care to ensure that subcomponents are correctly assembled and evenly tightened, and that no damage occurs while tightening the insulators or inserting the carrier pipe.

Seal the annulus between the carrier pipe and casing with casing end seals at each end of the casing.

Insular spacing Specifications are as follows.

- Provide spacing as shown on the plans with a maximum distance between spacers of 10 ft. for pipe sizes 4 in.–14 in. and 8 ft. for pipe sizes 16 in.–30 in.
- For DIP, flanged pipe, or bell-and-spigot pipe, install spacers within 1 ft. on each side of the bell or flange, and one in the center of the joint when 18-ft.–20-ft. long joints are used.
- If the casing or carrier pipe is angled or bent, reduce the spacing. Provide the casing with a smooth, continuous interior surface.

Perform bedding and backfilling of jacking, tunneling, boring, or augering pits in conformance with the plans and these Specifications.

3.2.2. **Jacking Steel Casing**. Perform jacking of steel casing in accordance with Item 476.

3.2.3. **Tunneling**. Perform tunneling in accordance with the tunneling requirements of Item 476.

3.2.4. **Boring or Augering**. Perform boring or augering in accordance with Item 476.

Do not exceed 100 ft. for the length of the auger hole without a receiving pit.

Do not exceed 75 ft. for the length of the auger hole for PVC pipe 12 in. and less in diameter without a receiving pit.

Do not exceed 40 ft. for the length of the auger hole for PVC pipe 16 in. and greater in diameter without a receiving pit.

At locations where water pipes cross underneath driveways (of 16 ft. or less in width) or sidewalks, install the pipe in tight-fitting augered holes.

At locations where the centerline of the proposed water main is 10 ft. or less from the centerline of an 8-in. diameter or larger growing tree, place the pipe in a tight-fitting augered hole. Extend the bored hole at least 4 ft. beyond each side of the tree.

Block the void space around the pipe in the augered hole with approximately 12 in. of packed clay or similar approved material, so that the bedding or backfill does not escape into the void around the pipe in the auger hole when compacted.

Around the pipe, use the minimum volume of the clay or similar acceptable material as shown in Table 11.

Table 11
Volume of Clay or Acceptable Material for Blocking Voids

Pipe Diameter (in.)	Minimum Quantity (cu. ft.)
4–8	0.5
12–16	0.75

3.2.5. **Bedding for Trenches and for Jacking, Tunneling, Boring, or Augering Pits**.

3.2.5.1. **Pipe Bedding for Water Mains Less than 24 in. in Diameter**.

3.2.5.1.1. **Open-Cut Trench Installation**. Construct trenches with at least 6 in. of bedding. Remove the soil in the bottom of the trench, excavate to a minimum depth of 6 in. below the bottom of the pipe, and replace the soil with bedding material. Remove saturated material from the bottom of the pit before placing the bedding. Place the pipe in the bedding such that there is 6 in. of bedding below and up to the spring line of the pipe.

Compact the bedding material to within 95% of the standard density within 5% of the optimum moisture as determined by Tex-113-E. Mechanically compact the bedding material using vibratory equipment or any other acceptable equipment.

3.2.5.1.2. **Jacking, Tunneling, Boring, or Augering Pits**. Construct pits with at least 6 in. of bedding. Remove the soil in the pit, excavate to a minimum depth of 6 in. below the bottom of the pipe, and replace the soil with bedding material.

If the bottom of the excavation becomes wet due to the presence of groundwater and a dewatering system is not required, and if directed, overexcavate an additional 6 in. to a depth of 1 ft. below the bottom of the pipe. Place a nonwoven geotextile fabric and then compact 12 in. of bank run sand or concrete sand in a single lift on top of the fabric. Compact the upper 6 in. to 90% of the standard maximum density as determined by Tex-113-E. The Engineer may require the Contractor to remove unstable or unsuitable material even if the Contractor does not determine the material to be unsuitable.

Mechanically compact the bedding material using vibratory equipment or any other acceptable equipment. Compact the bedding material to 95% of the standard density within 5% of the optimum moisture, as determined by Tex-113-E.

3.2.5.1.3. **Bedding Materials**. The following describes the acceptable materials for bedding.

- Section 2.14.1., “Bank Run Sand”
- Section 2.14.3., “Pea Gravel”

Bank run sand may be used as bedding material around the pipe only if, as determined by the Engineer, the trench bottom and sides are dry. If sand is used, place the pipe in the bedding so that there is at least 6 in. of bedding around and on top of the pipe. Compact the sand as described in Section 3.2.5.1.1., “Open-Cut Trench Installation.”

3.2.5.2. **Pipe Bedding for Water Mains 24 in. or Greater in Diameter**. For open-cut, provide pipe bedding as described in Section 3.2.5.1., “Pipe Bedding for Water Mains Less than 24 in. in Diameter,” but use bank run sand for the bedding material as described in Section 2.14., “Bedding Material.”

Compact cement-stabilized sand used as backfill or as pipe bedding as specified on the plans, in 6-in. lifts to 95% of the standard maximum density as determined by Tex-113-E, at the optimum moisture content.

3.3. **Handling Pipe and Accessories**. During pipe construction operations, use caution to prevent damage to the pipe, protective linings, and coatings in conformance with the manufacturer’s recommendations. Do not place debris, tools, or other materials in the pipe.

Repair any damage to the pipe or the protective lining and coating from any cause during the installation of the pipeline and before final acceptance by the purchaser. Perform this work as directed, in conformance with the applicable standards, and at no cost to the Department.

Unload pipe, fittings, valves, and accessories at the point of delivery and haul them to the project site. Distribute the material opposite or close to the place where it will be laid in the trench such that stormwater or runoff will not enter or pass through the pipe. Do not drop the materials. Do not allow pipe handled on skidways to be skidded or rolled against pipe already on the ground.

Load, transport, unload, and otherwise handle pipe and fittings in a manner and by methods that prevent damage of any kind. Handle and transport pipe using equipment designed, constructed, and arranged to prevent damage to the pipe, lining, and coating. Do not allow bare chains, hooks, metal bars, or narrow skids or cradles to contact the coatings. Provide pipe fittings with enough interior strutting or cross-bracing to prevent deflection under their own weight.

Hoist the pipe and fittings from the trench side into the trench using a sling of smooth steel cable, canvas, leather, nylon, or similar material. Do not lift pipe using hooks at each end of the pipe. When stacking pipe, ensure it is packaged on timbers. Place protective pads under the banding straps at the time of packaging.

When using fork trucks to relocate pipe, pad the forks using carpet or some other suitable type of material. When relocating pipe using a crane or backhoe, use nylon straps or smooth steel cable. Do not use chains around the pipe for lift.

3.4. **Cutting Pipe**. Cut pipe 12 in. in diameter and smaller in conformance with the manufacturer's recommendations. Cut pipe larger than 12 in. in an approved manner. Perform each cut at right angles to the axis of the pipe and file or grind to remove sharp edges. Use a cutting machine unless otherwise approved. Do not damage pipe or linings and coatings while cutting.

3.5. **Defective or Damaged Material**. Inspect pipe and accessories for defects before lowering into the trench. Repair or replace any defective, damaged, or unsound material as directed.

If a damaged piece of pipe, furnished by the Contractor, is placed in the water main, furnish the labor and materials necessary to remove and replace the defective pipe and to restore the street to its original condition at no cost to the Department. If the Contractor damages the pipe after installation, the Engineer may permit the damaged section to be cut from the length, unless it is the opinion of the Engineer that the entire length was damaged. The cost and replacement of broken pipe are at the expense of the Contractor.

3.6. **Cleaning Pipe and Accessories**. Remove lumps, blisters, and excess coating from the bell-and-spigot ends of steel pipe, DIP, valves, hydrants, and fittings. Wire-brush the outside of the spigot and the inside of the bell and wipe clean, dry, and free of oil and grease before laying the pipe.

Remove foreign matter or dirt from the interior of water pipe, accessories, and the mating surfaces of the joints, before lowering the material into the trench. Keep the pipe and accessories clean during and after laying using approved means.

Use chemicals such as cleaning solutions, detergents, and solvents with caution when cleaning PVC pipe.

Provide cleanup and restoration crews to work closely behind the pipe-laying crews and, where necessary, during disinfection, testing, service transfers, abandonment of old mains, backfilling, and surface restoration.

Upon completely installing a section not exceeding 4,000 ft. per crew, immediately prepare to disinfect and pressure-test between valves or plugs. No later than 3 days after completing disinfection preparatory work, submit to the utility owner an appropriate request for disinfection.

Begin transfer of services no later than 7 calendar days after successfully completing the disinfection and pressure-testing.

Immediately after transfer of services, begin abandonment of the old mains, including resodding and placing sidewalks and pavements.

Do not begin construction of additional sections if the above conditions are not met.

For large-diameter water mains, do not install more than 2,000 ft. of main, until the previous 2,000 ft. is cleaned up and the site is fully restored. Schedule paving crews so that the repaving work will not lag behind the pipe-laying work by more than 1,000 ft.

Completely restore the site within 30 days from the date the water main is disinfected and hydrostatically tested, unless extended in writing by the Engineer.

For projects involving multiple locations, limit water main installation to at most two project site locations.

Remove construction debris or foreign material and thoroughly clean and flush piping systems as approved. Provide temporary connections, equipment, and labor for cleaning. The Engineer will inspect the water main for cleanliness before filling.

To disinfect of water lines, conform to Section 3.17., "Disinfecting Mains and Testing for Leakage."

3.7. **Laying Pipe**. For pipe-laying, employ only workers who are skilled and experienced in laying pipe of the type and joint configuration being furnished. Provide watertight pipe and pipe joints. Lay pipe with the bell ends facing in the direction of laying, unless otherwise directed.

Lay pipe to the lines and grades shown on the plans. To ensure proper placement, use adequate surveying methods and equipment, and employ personnel competent in using this equipment. Ensure the pipe does not deviate from the horizontal and vertical alignment indicated on the plans by more than 0.10 ft., without prior approval. Measure and record the as-built horizontal alignment and vertical grade at most every 50 ft. on the onsite recorded plans.

During pipe-laying operations, keep pipe trenches free of water that might impair the laying operations. Ensure holes for bells are of ample size to prevent the bells from contacting the subgrade. Carefully grade pipe trenches to provide uniform support along the bottom of the pipe.

Do not lay more than 50 ft. of pipe in the trench ahead of the backfilling operations. If pipe-laying operations are interrupted overnight, cover the pipe laid in the trench simultaneously on each side of the pipe or completely backfill, to avoid lateral displacement of the pipe and damage to the joints. If adjustment of the position of a length of pipe is required after it is laid, remove and re-lay it in conformance with these Specifications and at no expense to the Department. After pipe-laying and joining operations are complete, clean the inside of the pipe and remove debris.

Use care to prevent damage to the coating when placing backfill. Backfill in accordance with Section 3.11., "Backfilling."

Lay pipe in a straight line unless otherwise shown or approved. Long-radius curves, either horizontal or vertical, may be laid with standard pipe using deflections at the joints. If curved pipe is shown, needing no special fittings, the curves may be made by deflection of the joints with standard lengths of pipe as approved. If maximum pipe joint deflections are permitted, do not exceed the manufacturer's recommendation for maximum pipe joint deflections. Joint the gasketed pipe in a straight alignment, and then deflect it to the curved alignment.

If the vertical deflection exceeds the maximum recommended by the manufacturer, remove the entire portion of the deflected pipe section and install new pipe as directed. Perform this work at no expense to the Department. The Engineer may measure assessment of deflection at any location along the pipe. Arithmetical averages of the vertical deflection or similar average measurement methods are not deemed as meeting the intent of the standard.

Where field conditions require horizontal deflection curves not shown on the plans, the Engineer will determine the methods to be used.

No additional payment will be made for laying pipe on curves as shown, or for change orders involving standard lengths of pipe deflected at the joints. Adjust the pipe, valves, hydrants, and fittings to be at their proper locations and prepare each joint as specified in Section 3.8., "Joining Pipe and Accessories." As each joint of pipe is laid in the trench, center the spigot end in the bell of the previously laid pipe, then force home the pipe and bring it to the correct line and grade. Ensure each length of pipe rests on the bottom of the trench and is inspected for damage throughout its entire length.

When pipe-laying is discontinued for the day or for an indefinite period, tightly place a cap or plug in the end of the last pipe laid to prevent intrusion of water. When water is excluded from the interior of pipe, place enough backfill on the pipe to prevent floating. Schedule the work to prevent the possibility of flotation. Remove from the trench any pipe that has floated and re-lay as directed.

When assembling PVC pipe on top of the trench, allow it to cool to ground temperature before backfilling, to prevent pullout due to thermal contraction.

Do not schedule night work or plant shutdown to begin within 2 working days before or after utility-owner designated holidays.

For tie-ins to existing water mains, provide the necessary material on hand to facilitate connection before shutting down the existing water main.

Ensure that separation from gravity sanitary sewers and manholes, or from force mains, is at least 9 ft. of clearance in all directions or as specified, unless a special design is shown on the plans.

Minimum clearance of this Specification is as follows.

- **Parallel Water Line and Gravity Sanitary Sewer Force Main, or Manhole with No Leaks**. Minimum 4-ft. horizontal clearance from the outside wall of the water line to the outside wall of the gravity sanitary sewer, force main, or manhole.
- **Water Line Crossing Above Gravity Sanitary Sewer or Force Main with No Leaks**. Minimum 2-ft. vertical clearance.
- **Water Line Crossing Below a Sanitary Sewer or Force Main with No Leaks**. Minimum 2-ft. vertical clearance.

3.8. **Joining Pipe and Accessories**.

3.8.1. **DIP, Valves, Hydrants, and Fittings**. After thoroughly cleaning the inside of the bell and the outside of the spigot, install members in conformance with the manufacturer's recommendation and AWWA C 600, or as modified by these Specifications.

Mark pipe and accessories that are not furnished with a depth mark before assembly to ensure that the spigot end is inserted to the full depth of the joint.

Brace the fittings on small mains with short pieces of 2-in. galvanized pipe as directed.

Brace each plug installed under this Contract by a standard pipe clamp, a 3-ft. nipple of the same diameter pipe as the nearby sections of mains, and a block of concrete.

For 4-in.–12-in. water mains, use pipe clamps that are UL-approved for underground water service piping. For water mains 16 in. and larger, use pipe clamps conforming to the plans.

For rubber-gasketed joints, use lubrication that is water-soluble, nontoxic, nonobjectionable in taste and odor imparted to the fluid, and nonsupporting of bacteria growth, and that has no deteriorating effect on coatings or rubber gaskets.

3.8.2. **PVC Pipe and Accessories**. Join plastic pipe in conformance with the instructions furnished by the manufacturer. To prevent weakening the joint, do not handle or install in the trench pipe joined using solvent-cementing techniques until the joints cure.

For rubber-gasketed joints, use lubrication that is water-soluble, nontoxic, nonobjectionable in taste and odor imparted to the fluid, and nonsupporting of bacteria growth, and that has no deteriorating effect on PVC or rubber gaskets.

3.8.3. **Welded Joints for Steel Pipe**. Ensure the joints receive a full-penetration butt-weld type double weld, in accordance with AWWA C 206. It is the Contractor's option to use either automatic or hand welders. Before starting the work, provide proof of certification of qualification for welders employed on the project for every type of work procedure and position involved. Ensure qualification is in accordance with AWWA C 206. Ensure complete penetration of deposited metal with the base metal. Provide inside fittings and joints that are free of globules of weld metal that would restrict flow or become loose.

Miter end cuts of both ends of butt-welded joints may be used for joint deflections up to 2.5°.

Set fittings and joints square and true, and preserve the alignment during welding operations. Align the butting ends to minimize the offset between surfaces. For pipe of the same nominal wall thickness, do not exceed 1/16-in. offset. Use lineup clamps for this purpose; however, exercise caution to avoid damaging to the linings and coatings.

Furnish each welder employed with a steel stencil for marking welds, so the work of each welder can be identified. Mark pipe with the assigned stencil adjacent to the weld. If a welder leaves the job, void that stencil and do not duplicate it. Welders making defective welds must discontinue work and leave the project site. Such welders may return to the project site only after recertification.

During welding, protect the lining by draping an 18-in. wide strip of heat-resistant material over the top half of the pipe on each side of the lining holdback to avoid damage to the lining by the hot splatter. Protect the tape coating similarly.

Provide welding rods of a type compatible with the metal being welded, to obtain the strongest bond, E-70XX.

Deposit the metal in successive layers so there will be at least two passes or beads for automatic welding and three passes or beads for manual welding in the completed weld.

On welds, do not deposit more than 1/4 in. of metal on each pass. Thoroughly clean the weld by wire-brushing and hammering on each pass, including the final one, to remove dirt, slag, or flux.

Do not perform welding under any weather condition that would impair the strength of the weld, such as wet surface, rain or snow, dust, or high winds, unless the work is properly protected.

If using tack welds, ensure they are of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during the welding operation.

Remove dirt, scale, and other foreign matter from the inside of piping before tying in sections, fittings, or valves.

Provide a minimum overlap of 4 in. of butt strap over the adjacent piece on butt strap closures.

Employ an approved independent certified testing laboratory to perform weld tests and associated work to accommodate testing on the entire job. Include the cost of such testing in the Contract unit bid price for the water main. Furnish copies of test reports to the Engineer for review. Ensure testing is by X-ray methods for butt welds and is performed for every joint weld. If a defective weld is revealed, assume the cost of repairing and retesting the repaired weld. The Engineer has the full and final decision regarding the suitability of welds tested. If any interior or exterior coating or lining is damaged during the welding process, repair it and return it to its original state as approved, in conformance with applicable AWWA standards.

Provide cylindrical corrosion barriers (CCBs) for epoxy-lined steel pipe smaller than 24 in. in diameter. Furnish CCBs manufactured by CCB International, Inc., or approved equal. CCBs are not required if the minimum wall thickness is 1/2 in. or greater.

In addition to the welding requirements contained in this Specification, conform to the protection fitting manufacturer's installation recommendations.

Provide the services of a technical representative of the manufacturer available onsite at beginning of pipe-laying operations. Ensure this representative can train welders and advise regarding installation and general construction methods. Employ only welders with at least 12 mo. of experience in installing protection fittings.

3.8.4. **Flanged Joints for Steel Pipe**. Before installing bolts, accurately center the flange joints and align them to prevent mechanical prestressing of flanges, pipe, and appurtenances. Align bolt holes to straddle the vertical, horizontal, or north-south centerline. The maximum inclination of the flange face from the true alignment is 3/64 in. per foot.

Use full-face gaskets for flanged joints. Provide 1/8-in. thick cloth-inserted rubber gasket material. Cut the gaskets at the factory to the proper dimensions.

Unless otherwise noted, provide insulation kits at connections to the existing water system or at locations to isolate one type of cathodic system from another type; between water line, access manhole piping, and other major openings in the water line; or as shown on the plans.

For isolating flange joints 30 in. in diameter and greater, and at butterfly valve flanges, provide a Pyrox G-10 with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal, conforming to ANSI A 21.11 mechanical joint gaskets. For isolating flange joints 24 in. in diameter and smaller, provide a Phenolic PSI with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal, conforming to ANSI A 21.11 mechanical joint gaskets.

Use galvanized or black nuts and bolts to match the flange material. Use cadmium-plated steel nuts and bolts under ground. Tighten the bolts progressively to prevent unbalanced stress. Consistently maintain approximately same distance between the two flanges at all points around the flanges. Tighten the bolts alternately (180° apart) until they are evenly tight. Draw the bolts right to ensure properly seating the gaskets. Provide Denso, or approved equal, petroleum-based tape-wrapping system for nuts and bolts.

Pay particular attention to procedures used in tightening and torquing flanged joints. Improper methods may result in leakage and require corrective measures. Follow recommended industry standards and guidelines as set forth by the various fabricators and manufacturers.

3.8.5. **Flanged Joints for Use on DIP**. See Section 3.8.4., "Flanged Joints for Steel Pipe."

3.9. **Thrust Restraint.** Provide adequate temporary blocking of fittings when making connections to the distribution system and during hydrostatic tests. Provide enough anchorage and blocking to resist stresses and forces encountered while tapping the existing water line. For new water lines 16 in. in diameter and larger, provide restraining joints as specified in this Section. Provide restrained joint lengths as shown on the plans or as directed. For existing water lines and water lines less than 16 in. in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in this Section.

The length of the restrained joints shown on the plans assumes that hydrostatic testing will begin upstream and proceed downstream with respect to the normal flow of the water in the pipe. If installation or testing of the pipe differs from this assumption, submit for approval a revised method of restraining the pipe joints upstream and downstream of the device used to test against (i.e., block valve, blind flange, or dished head plug).

3.10. **Electrical Continuity Bonds**.

3.10.1. **General**. Attach the bond wires at the required locations using the Thermite welding process.

3.10.2. **Thermite Welding Methods**. Perform Thermite welding of bond wires to the piping in the following manner.

Ensure the pipe to which the wires will be attached is clean and dry. Use a grinding wheel to remove coating, mill scale, oxide, grease, and dirt from an area approximately 3 in. square. Grind the surface to bright metal.

Remove approximately 1 in. of insulation from each end of the wires to be Thermite-welded to the structure, exposing clean, oxide-free copper for welding.

Select the proper size Thermite weld mold as recommended by the manufacturer. Place the wire between the graphite mold and the prepared metal surface. For No. 12 AWG size wires, use a copper sleeve crimped over the wire. Place the metal disk in the bottom of the mold. Place the Thermite weld charge in the mold. Squeeze the bottom of the cartridge to spread ignition powder over the charge.

Close the mold cover and ignite the starting powder using a flint gun. After the exothermic reaction, remove the Thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure with a new wire. If the weld is secure, coat bare metal and weld metal with a coal-tar compound. If a polyurethane dielectric coating has been used, use a compatible polyurethane coating.

3.11. **Backfilling**.

3.11.1. **General**. Backfill trenches in accordance with Item 400.

Begin backfilling and cleaning up each section of main (i.e., from valve to valve) immediately upon completing the hydrostatic test, unless otherwise permitted by Engineer, and continue until obtaining a final and complete cleanup of the section. Any portion of the trench that is left open more than that required to facilitate hydrostatic testing may be ordered closed by the Engineer.

Use surplus excavated materials in the embankments, or dispose of them as directed.

3.11.2. **Backfilling Pipe for Water Mains**.

3.11.2.1. **Open Cut**. After the pipe joints are made up and inspected, backfill the trenches with excavated materials or any other backfill material covered by this Specification, as approved. Backfill the portion from the spring line of the pipe (or from 6 in. on top of pipe if sand bedding is used) to the top of the trench in maximum lifts of 9-in. loose measurement (provided the trench is not located in areas used for automobile or pedestrian traffic, such as sidewalks, roadways, roadway shoulders, and driveways). Mechanically compact the backfill material using vibratory equipment, or any other acceptable equipment, so that no settlement occurs.

Compact to a density of at least 95% of the maximum dry density, as determined in accordance with Tex-114-E. The Engineer reserves the right to perform compaction tests on an as-needed basis. Compaction by water tamping is prohibited.

Do not allow dirt, clods, or trench sides to fall or rest against the pipe before completing the embedment or backfill.

The allowable materials for backfill are listed in Section 2.15., "Backfill Material."

Continue backfilling and compacting in this manner to the minimum elevation shown in the excavation and backfill diagram.

3.11.2.2. **Boring or Augering Pits**. Backfill boring or augering pits with bank run sand up to 1 ft. from the top of the natural ground. For the final 12 in., use backfill consisting of 10 in. of native soil in the bottom and 2 in. of bank run sand just below the grass.

Backfill the portion from the spring line of the pipe to the top of the pit in lifts not exceeding 9 in. (loose measurement). Mechanically compact the backfill using vibratory equipment, or any other acceptable equipment, so that no settlement occurs. Compact the material to a density of at least 95% of the maximum dry density at optimum moisture content as determined in accordance with Tex-113-E or Tex-114-E. The utility owner may perform compaction tests on an as-needed basis. Compaction by water tamping is prohibited.

Do not allow dirt, clods, or auger pit sides to fall or rest against the pipe before completing the embedment or backfill.

The only allowable material for backfill in boring or augering pits is bank run sand, described in Section 2.15., "Backfill Material."

3.12. **Valves and Fire Hydrants**. Ensure each valve and fire hydrant is completely closed when placed in the pipeline.

Install valves and hydrants in accordance with AWWA C 600, except where modified by this Specification. Provide drainage at the base of the hydrant in accordance with AWWA C 600.

Set each hydrant at the location and grade indicated by the stakes, and plumb, brace, and install in accordance with AWWA's requirements for fire hydrant installation. If the barrel of a hydrant is to pass through a concrete slab, fit a piece of 1-in. thick preformed bituminous expansion joint material closely around the section of the barrel passing through the concrete.

Locate the nozzle centerline at least 18 in. above the finish grade.

Place 12-in. × 12-in. yellow indicators (plastic, sheet metal, plywood, or other approved material) on pumper nozzles of new or relocated fire hydrants installed on new mains not in service. Remove indicators after the new main is tested and approved.

3.13. **Tapping Sleeves and Valves**.

3.13.1. **General**. Install tapping sleeves and valves at the locations and using the sizes shown on the plans. Thoroughly clean the tapping sleeve, tapping valve, and pipe in conformance with the manufacturer's instructions before installing.

Hydrostatically test the installed tapping sleeve to 150 psig for at least 15 min. Inspect the sleeve for leaks, and remedy any leaks before the tapping operation.

When tapping concrete pressure pipe, size-on-size, use a shell cutter one standard size smaller than that of the water line being tapped. Do not use LEB increases with a next-size tap except for existing asbestos-cement (AC) pipe.

3.13.2. **Installation**. Verify the OD of the pipe to be tapped before ordering the sleeve. Tighten the bolts in the proper sequence to avoid placing undue stress on the pipe. Align the tapping valve properly and attach it to the tapping sleeve. Insert the insulation sleeve into the flange holes of the tapping valve and pipe. Insert the sleeve on pipe side of tapping valve. Do not damage insulation sleeves during the bolt-tightening process.

Make the tap using a sharp shell cutter. For 12-in. and smaller taps, use a minimum cutter diameter 1/2 in. less than the nominal tap size. For 16-in. and larger taps, use the manufacturer's recommended cutter diameter.

Withdraw the coupon and flush the cuttings from the newly made tap. For 12-in. and smaller taps, wrap the completed tapping sleeve and valve in accordance with this Specification.

For 16-in. and larger taps, apply Denso or approved equal petroleum-based tape-wrapping system around the completed tapping sleeve and valve. Place the concrete thrust block behind the tapping sleeve (not over the tapping sleeve and valve).

Arrange for the mandatory inspection of the installation before backfilling. Completion of the inspection is not required before backfilling. Backfill in accordance with this Specification and as shown on the plans.

If AC pipe is encountered, follow the safety practice outlined in the Asbestos-Cement Pipe Producers Association publication *Recommended Work Practices for A/C Pipe*, and address the encounter as a Mandatory Practice for this project.

3.14. **Boxes for Valves**. Cut the cast iron pipe or DIP to the proper length. Then assemble and brace the box as approved. Construct manholes over the operators of butterfly valves for sizes 30 in. and larger.

For concrete for valve box placement, at locations in new concrete pavement, use the same strength and mix design as those of new pavement. For other locations, use Class A concrete, conforming to Item 421.

Install valve box and riser piping plumbed in a vertical position. Provide 6-in. telescoping freeboard space between the riser pipe top butt end and the interior contact flange of the valve box, for vertical movement damping. Ensure the riser (bell end of pipe) rests on the valve flange. or provide a suitable foot piece to support the riser pipe.

Set, align, and adjust the valve box so that the lid is level with the final grade.

Paint the covers of new valve boxes fluorescent orange when installed. After completion and approval, repaint the covers black.

3.15. **Wet Connections**. Make the wet connections, as directed, in such a manner and at such hours to minimize inconvenience to the public. When the existing mains are cut or a plug removed for a connection, pursue the work of making the connection without interruption until complete.

If the Contractor proceeds with a wet connection without a complete shutoff, there will be no extra compensation for damages or extra work resulting from the incomplete shutoff.

The utility owner will operate gate valves in the existing system and in sections of completed mains that have been placed in service. Notify the utility owner at least 48 hr. before making connections.

Wet connections that are 2 in. or smaller are sometimes referred to on the plans as 2-in. standard connections or gooseneck connections.

Items that may be necessary to complete these types of wet connections include corporation cock, saddle, copper tubing, brass fittings, and 2-in. valves. Do not use these connections on or consider them as part of a 2-in. service line.

The utility owner will undertake, at no cost to the Contractor, operations involving opening and closing valves for wet connections.

3.16. **Polyethylene Film Wrap**. Except as noted on the plans, wrap DIP (including fittings and other appurtenances) with a polyethylene film. Also wrap fire hydrant barrels.

Remove lumps of clay, mud, and cinders on the pipe surface before installing the polyethylene encasement. Prevent soil or embedment material from becoming trapped between the pipe and the polyethylene. Fit the polyethylene film to the contour of the pipe to achieve a snug, but not tight, fit. Encase with minimum space between the polyethylene and the pipe. Provide enough slack in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.

For installations below the water table and in areas subject to tidal actions, seal both ends of the polyethylene tube with adhesive tape at the joint overlap.

Repair any cuts, tears, punctures, or damage to the polyethylene with adhesive tape or with a short length of polyethylene sheet or cut open tube, wrapped around the pipe to cover the damaged area, and secured in place.

Provide openings in encasement for branches, service taps, blowoffs, air valves, and similar appurtenances by making an “X”-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as other damaged areas in the polyethylene, with tape. Service taps may also be made directly through the polyethylene. Repair any resulting damaged areas as described above.

For junctions between wrapped and unwrapped pipe, where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover the adjacent pipe for at least 3 ft. Secure the end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for a minimum clear distance of 3 ft. away from cast iron pipe or DIP.

3.16.1. **Tubular-Type Wrap**. When the polyethylene film is supplied in tubular form, install it on the pipe before placing the pipe in the trench and in the following manner.

Elevate the spigot end of the pipe, brush mud and debris from the pipe, and slip a length of film (approximately 2 ft. longer than the joint of pipe) over the joint of the pipe. Wrap the film tightly around the spigot end, leaving approximately 1 ft. extending beyond the end of the pipe, and tape the edge down lightly with polyethylene tape.

When lifting the joint of pipe for placing in the trench, remove any remaining mud, clay, or debris. Insert the spigot end into the bell end of the joint previously placed, push home, and release the pipe into the trench. Pick up the pipe joint at the bell, slide the film to a point in back of the bell, and prepare a bell hole.

When laying the next joint, pull the film beyond the bell to overlap the film attached to the spigot of the new pipe joint. Wrap the film by folding it longitudinally and tape it securely in place to prevent damage during backfill. Do not tape the end that is slipped over the last bell, but bind it with twine or other approved material.

At each corporation, draw the loose material up around the corporation base and seal it with tape to insulate the two dissimilar metals.

Wrap fittings and fire hydrant leads, and tape or bind the wrap with heavy twine. Wrap fittings, such as bends and reducers, similarly to the method outlined above. Wrap specials, such as valves, tees, and crosses, by splitting, tucking, and overlapping the polyethylene tube, then closing the field-made splices with the required tape. Material to cover the valves may be acquired from excess overlapping polyethylene tubing on adjacent pipe joints. Draw the polyethylene tubing over the bell of the pipe on either side and insulate with field-made seams as described above. Completely wrap fittings and specials that require concrete blocking before placing concrete.

3.16.2. **Sheet-Type Wrap**. Apply sheet-type wrap around the pipe either before or after positioning the pipe in the trench. Install above ground in a manner like that described for tubular installation in Section 3.16.1., "Tubular-Type Rap." Install in trench in a manner like that described below.

Cut the polyethylene sheet to a length approximately 2 ft. longer than the pipe section. Center the length to provide a 1-ft. overlap on each adjacent pipe section, bunching it until it clears the pipe ends. Wrap the polyethylene around the pipe so that it circumferentially overlaps the top quadrant of the pipe. Secure the cut edge of the polyethylene sheet at intervals of approximately 3 ft.

Lower the wrapped pipe into the trench and make up the pipe joint with the preceding section of pipe. Make shallow bell holes at joints to facilitate installation of the polyethylene. After completing the joint, make the overlap and secure the ends.

Repair cuts, tears, punctures, or other damage to the polyethylene. Proceed with installing the next section of pipe in the same manner.

3.16.3. **Boring or Augering Section Installation**. Use cast iron pipe or DIP with a polyurethane coating as specified herein.

Provide a final seal against the intrusion of the backfill material by completely encasing the tapping sleeve with sheet vinyl of 8-mil thickness. Apply tape to secure this wrapping, using Polyken No. 900, Scotch Wrap No. 50, or approved equal, manufactured for this purpose.

3.17. **Disinfecting Mains and Testing for Leakage**.

3.17.1. **Disinfecting Mains**. The utility owner will furnish water for disinfecting and flushing without charge to the Contractor.

Furnish the necessary taps, risers, and jumpers of such sizes and materials as specified by the Engineer and install the subject material in the locations designated. Normally, each valve section of main requires two 3/4-in. taps; however, on larger mains, the Engineer may order that 1-1/2 in. or 2-in. taps and risers be used.

Furnish and install the necessary temporary blind flanges, sleeves, and plugs as required to disinfect and pressure-test the new mains.

Use fire hydrants as blowoffs to flush newly constructed water lines 8 in. in diameter and more.

After laying and backfilling the pipe, disinfect the newly laid pipe. Unless otherwise shown on the plans, the utility owner will furnish and pay for the labor and materials necessary for the initial application of the disinfecting agent. Slowly fill each valve section of pipe with water and expel the air from the pipe. Furnish and install taps at the points of highest elevation, if required to accomplish this. After filling the main with water and expelling the air, charge the pipe with the disinfecting agent and allow it to stand for 24 hr. Unless otherwise shown on the plans, the utility owner will then flush the main with water. After flushing, draw samples from the main and test for 2 consecutive days at a valid, approved testing facility. After samples are drawn and the test results pass, proceed with the pressure test and any necessary repairs. If the samples do not pass, re-disinfect the pipe until the samples taken are passed by the certified and approved testing facility. Unless otherwise shown on the plans, if more than one disinfection of the main (or portion of the

main) is required, the additional disinfection will be charged to the Contractor at rates established by the utility owner.

After disinfecting and flushing water lines, bacteriological tests will be performed by the utility owner or testing laboratory.

When test results indicate a need for additional disinfection of water lines based on Texas Department of Health requirements, assist utility owner with additional disinfection operations.

3.17.2. **Testing for Leakage**. Following the first disinfection test, subject the newly laid pipes to a hydrostatic pressure of 125 psi, unless otherwise shown on the plans. Where practicable, test pipelines in lengths between line valves or plugs, of at most 1,500 ft., unless otherwise approved. Perform the pressure test using a pump connected to the pipe in a manner satisfactory to the Engineer. Furnish, install, and operate the necessary connections, pump, meter, and gauges. Before running the pressure test, ensure the meter is tested; sealed; and approved (at the Contractor's expense) by an approved, certified testing facility. Ensure the minimum duration of the test is 8 hr. If a large quantity of water is required to maintain pressure during the test, discontinue testing until the cause of the water loss is identified and corrected.

Observe the following general regulations during each leakage test for cast iron pipe, DIP, and PVC pipe.

Except for welded steel pipe in which no leakage is permitted, ensure that pipelines, when subjected to the specified pressure test, do not show leakage of more than 3.19 gal. per inch of diameter, per mile, in 24 hr.

Repair portions of the pipe showing visible leaks regardless of the total leakage shown by the pressure test. Remove and replace cracked or defective pipes, fittings, valves, or hydrants discovered by this pressure test with sound material. If the main is opened for any reason, re-disinfect it until satisfactory samples are obtained. Also, pressure-test it until this Specification is met.

Immediately upon completing disinfection and pressure-testing, remove all taps, risers, and blowoffs. Then backfill the remainder of the trench in accordance with this Specification.

Perform leakage testing at no additional cost to the Department.

3.18. **Using Completed Sections of Mains**. The utility owner may use and operate portions of the water mains that are disinfected and pass the leakage test. Unless otherwise shown on the plans, operate the valves in such completed sections only with the express permission of the utility owner.

The use of the mains is not construed as acceptance of them and does not relieve the Contractor's responsibility for fulfilling the conditions of the Contract, unless the mains are damaged due to negligence on the part of the utility owner.

3.19. **Lowering Mains**. When lowering a main, perform the initial excavation in such a manner to permit the mains to rest on several dirt benches. If soil conditions are unsatisfactory for dirt benches, use wooden blocks to support the mains. Then attach the pipe by using ropes, cable, or chains to overhead supports; remove the dirt benches or wooden blocks; and slowly and evenly lower the pipe into position. After lowering the mains, repair each damaged joint as directed.

3.20. **Copper Service Line Construction**. The use of Hays-Seal and Mueller Company catalog numbers to describe various fittings is not intended to be proprietary, but merely to indicate clearly the respective types of fittings to be furnished.

3.20.1. **Installing Service Lines**. For curb and gutter streets, lay copper service lines with a minimum 30 in. of cover from top of curb to the top of the service line. For crowned streets with open ditches, lay copper service lines with a minimum 30 in. of cover at the crown and with a minimum 18 in. of cover from the flow line of the ditch

to the top of the service line. Ensure service line locations are clear of proposed paving and underground work.

Exercise caution to always keep the lines free of dirt and foreign matter. Assemble copper lines in an entirely slack position and free of kinks. Use service lines consisting of one continuous run of copper tubing where possible. Do not use bends greater than that originally found in the coil of tubing as packaged.

For 1-1/2 in. and 2-in. copper tubing shipped in straight lengths, use the following bend criteria.

For 2-in. copper tubing, at most one 45° bend may be accomplished in a 4-ft. section, and for 1-1/2 in. copper tubing, one 45° bend in a 3-ft. section. No kinks, dents, flats, or crimps are permitted.

Locate meters, in general, 1 ft. into the street right of way. Where this is not applicable, locate meters approximately 1 ft. from the sidewalk on the curb side. If the current meter location conflicts with proposed driveway turnouts or other proposed street improvements, shift the meter to miss the obstruction and reconnect it to the customer's service line. Reset meters at positions such that the top of the meter is 4 in.–6 in. below the finished grade.

Where the plans call for salvaging and relocating the meter, meter box, and curb stop, remove these materials with care, thoroughly clean them, and submit them for inspection by the Engineer, before installing them in the new location. If the plans call for relocating the meter (other than at some point along the existing service line), a new service line is required.

Where it is necessary to cross a paved street, push the service line under the paving through a predrilled and prepared opening. Use only full lengths of copper tubing, taking care not to damage the tubing when pulling it through the prepared hole.

A compression-type union is permitted only when a full 40-ft. (60 ft. for 3/4 in.–1 in.) length of tubing cannot completely span underneath the pavement. Do not use compression-type unions under the paved street.

3.20.2. **Installing Corporation Stops**. Tap the main at a location such that a straight line passing through the meter and the corporation stop will be at 90° to the main. Locate taps in the upper portion of the main within 45° of the pipe spring line. Perform the cutting operation using an approved sharp shell cutter tool.

Install taps for service lines conforming to Table 12. Space taps at least 2 ft. apart.

Table 12
Service Tap Requirements for Service Lines

Water Main Type and Diameter	Service Size Diameter			
	3/4 in.	1 in.	1-1/2 in.	2 in.
4-in. cast iron or ductile iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
4-in. AC	WBSS	WBSS	DSS, WBSS	DSS, WBSS
4-in. PVC (AWWA C 900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6-in. and 8-in. cast iron or ductile iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6-in. and 8-in. AC	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6-in. and 8-in. cast iron or ductile iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6-in. and 8-in. PVC (AWWA C 900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12-in. cast iron or ductile iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12-in. AC	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12-in. PVC (AWWA C 900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
16-in. and more cast iron or ductile iron	DWBSS	DWBSS	DWBSS	DWBSS
16-in. and more AC	DWBSS	DWBSS	DWBSS	DWBSS
16-in. and more PVC (AWWA C 900)	DWBSS	DWBSS	DWBSS	DWBSS

Note—DSS = Dual strap saddles.
DWBSS = Dual wide-band strap saddles.
WBSS = Wide-band strap saddles.

3.20.3. **Installing Curb Stops**. Set curb stops or angle stops only at the outer end of the service line just ahead of the meter. Secure the opening in the curb stop to prevent unwanted material from entering. Use eighth-bend or quarter-bend couplings to accomplish close-quarter turns in the service line.

In 3/4-in. and 1-in. services, install a meter coupling or swivel nut meter spud curb stop, ahead of the meter. Also install a straight meter coupling on the outlet end of the meter. Install a new curb stop when the service line is extended.

3.20.4. **Sequence of Work**. Open the trench for the proposed service line or prepare the jacking and receiving pits.

Install the corporation stop in a workmanlike manner using the proper equipment.

Install the copper service line and connect it to the corporation stop.

Install the curb stop on the meter end of the service line.

With the curb stop open, and before connecting the service line to the meter, open the corporation stop and flush the service line adequately. Close the curb stop, leaving the corporation stop in the fully open position.

Check the service line for apparent leaks. Repair leaks before proceeding.

Connect the service line to the meter and, if necessary, adjust the meter location. Use care to ensure that the inlet side of the meter is connected to the water service line. Momentarily open the curb stop to verify proper registration of the meter.

Backfill the excavations, tamping the backfill material in place to the density of the soil in the adjacent trench walls.

If relocating the meter, relocate the meter box so that it is centered over the meter with the top of the lid flush with the finished grade. When the meter must be in driveways or sidewalks, furnish and install an approved traffic-type meter box with a cast iron lid.

3.21. **Cutting and Plugging Water Mains**. Where the plans call for abandoning water mains, adhere to the following general procedure.

After constructing, disinfecting, testing, and placing the replacement main in service, and services are transferred to the replacement main, locate the main to be abandoned, trace it back to the feeder main, and at this point cut and plug it at the tee. Normally, installing a plug, clamp, and a concrete thrust block accomplishes this. In cases of 1-1/2 in. or 2-in. corporation cock or tapping sleeve and valve connections, remove the valve and install a cap or plug at the tee. Ensure the line to be abandoned is not valves-off at the nearest valve or cut and plugged other than at the supply main.

Adequately plug the ends or openings in abandoned mains or cap them in an approved manner and replace excavation, backfill, and any street surfaces to the Engineer's satisfaction. Perform this work in accordance with Section 3.1., "Excavation," and Section 3.11., "Backfilling."

Remove surface identification (i.e., valve boxes and fire hydrants). Where valve boxes are in improved streets (other than shell), pouring valve boxes full of concrete with the cap permanently removed is permitted.

Do not remove plugs during the months of peak water demands (June, July, and August) unless otherwise approved.

3.22. **Service Lines of Public Utilities**. Where any pipe or conduit of a public utility corporation crosses the water main trench, support such pipe or conduit in a manner satisfactory to the Engineer.

If the Contractor considers it necessary for a utility company to relocate their utility lines or other improvements, notify the Engineer in advance.

If the Engineer considers it imperative to make the change, the Engineer will make the necessary arrangements with the utility company.

3.23. **Relocating Meter Vaults**. Salvage existing valves, meters, and strainers from inside the vault and return them to the utility owner, or as designated on the plans.

Install pipe, valves, service lines, and other appurtenances in accordance with this Specification or as directed.

In general, install the type of meter vault shown on the plans or as approved.

3.23.1. **Precast Concrete Vault**. Construct and furnish the precast concrete vault as shown on the plans.

Set the precast concrete vault level on a minimum 3-in. bed of sand in an excavation and bring it to grade. Then install piping and backfill with sand around the vault.

3.23.2. **Cast-in-Place Concrete Vault**. Construct the cast-in-place concrete vault as shown on the plans. Key the walls to the floor slab and form to the dimensions shown on the plans. Provide a minimum wall thickness of 4 in. Cast the walls monolithically. One cold joint is allowed when the vault depth exceeds 12 ft. Set the frame for the cover while the concrete is still green.

3.23.3. **Frame and Cover**. Construct the frame and cover as shown on the plans.

In grass areas, set the frame and cover 2 in.–3 in. above the natural ground or finished grade and parallel to it (the maximum allowable angle from horizontal is 20°). Slope the backfill away from the meter.

In sidewalk areas, set the frame and cover 1/2 in.–1 in. above the adjacent concrete and parallel to it. Slope the replacement concrete away from the meter to meet the adjacent concrete.

3.23.4. **Inspections**. The following inspections will be made jointly by the Engineer and representatives of the utility owner.

- **Site Location Inspection**. To obtain the required approval of proposed meter location before commencing work.
- **Final Inspection**. Conducted after the backfill is in place, the cover is installed, the cleanup is completed, and the surface is restored.

3.24. **Adjusting Existing Surface Structures**.

3.24.1. **Valve Boxes**. Salvage and reuse the valve box. Remove and replace the 6-in. ductile iron riser pipe with a suitable length for the depth of cover required to establish the adjusted elevation to accommodate the actual finished grade.

Reinstall the valve box and riser piping plumbed in a vertical position. Provide a minimum 6-in. telescoping freeboard space between the riser pipe top butt end and the interior contact flange of the valve box, for vertical movement damping.

After setting, aligning, and adjusting the valve box so that the top lid is level with the final grade, place a 24-in. × 24-in. × 8-in. thick concrete block around the valve box. Center the valve box horizontally within the concrete box.

3.24.2. **Meter Boxes**. Salvage and reuse meter boxes when possible. Reinstall them in conformance with the manufacturer's recommendations. Repair any damage sustained by the meter box during relocation or service transfer at no expense to the Department.

If the existing meter box requires replacement, the Contractor may obtain a new box from the utility owner by providing adequate documentation of the existing and proposed locations.

3.24.3. **Meter Vaults**. Adjust meter vaults in conformance with the details shown on the plans. Salvage and reuse access covers.

3.25. **Relocating Water Meters and Boxes**. Salvage, clean, inspect, and install existing curb stops, meters, unions, and meter boxes at the new locations in conformance with this Section. When the meter and box are relocated, move them the minimum distance to enable access for new connections. Repair any damage sustained by the meter box during relocation or service transfer at no expense to the Department.

If unable to salvage the existing boxes, the Contractor may obtain new boxes from the utility owner by providing proper documentation of the existing and proposed locations of the meter.

When approved, the Contractor may relocate meter boxes located adjacent to existing pavement, if this operation facilitates construction or decreases the costs. Obtain written approval and perform this work, including excavation, piping, meter box relocation, and removal and replacement of paving, at no cost to the Department.

3.26. **Installing Split Casing**. Notify the utility owner at least 48 hr. in advance of any work planned involving existing water lines. Do not, at any one time, expose more than 20 ft. of water lines to be encased.

Place 6-in. × 6-in. × 1-1/4 in. neoprene pads between the split casing sections and the top and bottom of the water lines, spacing them at approximately 6 ft. or as directed.

Ensure the completed and shaped trench to receive the casing is wide enough to provide free working space for satisfactorily installing the casing and backfilling under and around the casing.

Hold the split casing in place for welding using hinges, coupling bands, or any other acceptable method.

Use a casing diameter no less that the outside dimension of the pipe at is longest dimension plus 4 in.

Perform welds conforming to AWWA C 206. Provide welds capable of developing the full strength of the pipe throughout the joint and casing split.

Seal the ends of the encasement pipe with casing and seals in accordance with Section 2.2.1., "Steel Carrier Pipe," to prevent the entrance of excessive groundwater.

3.27. **Modifications for Cathodic Protection**.

3.27.1. **General**. Provide cathodic protection systems as shown on the plans.

References to steel pipe apply to tape-coated welded steel pipe. If damage occurs to the pipe coatings during the welding process, refurbish the affected area to its original condition.

3.27.2. **Bonded Joints**. Where rubber gasket bell and spigots are provided, provide for bonded joints by either welding a strap or clip between the bell and the spigot of each joint, or providing a Thermite-welded cable between the bell and the spigot of each joint. Provide pipes, whether installed in a tunnel or open-cut, with bonded joints, except where providing insulating flanges. Where welding joints for thrust restraint, no additional bonding is required.

Provide a strap or clip, for bonding the bell to the spigot, that is free of foreign material that could increase the contact resistance between the wire and the strap or clip.

Unless otherwise noted, provide insulation kits at connections to the existing water system, at locations to isolate one type of cathodic system from another type, between the water main and extra piping, or as shown on the plans.

3.28. **Removing and Salvaging Fire Hydrants and Water Meters**. Deliver removed and salvaged fire hydrants and water meters to the utility owner at the location shown on the plans, or as directed.

3.29. **Installing the Nonmetallic Pipe Detection System**. Install the nonmetallic pipe detection system concurrently with placing the proposed pipe. Install as specified by the manufacturer and as approved.

3.30. **Removing Water Mains and Removing Water Mains with Casing**. Remove water mains and water mains with casing in accordance with Item 100, or as shown on the plans. This includes removing and disposing of pipe and appurtenances as shown on the plans or as directed. Perform related excavation and backfilling, as required, at no additional cost the Department.

3.31. **Adjusting Manholes**. Perform work in accordance with Item 465. Excavate and backfill in accordance with Item 400. Carefully remove and temporarily store, as directed, manhole and inlet rings, covers, plates, and grates to be reused. Clean mortar and grease from the contact areas of reused items. Dispose of unused removed material as directed. Use construction methods described in Section 479.3.1., "Lowering the Top of a Manhole or Inlet," and Section 479.3.2., "Raising the Top of a Manhole or Inlet," unless otherwise shown on the plans.

3.31.1. **Lowering the Top of a Manhole or Inlet**. Remove a sufficient depth of brick courses or concrete to permit reconstruction on a batter not exceeding 1 in. horizontal to 2 in. vertical. Where brickwork is present, clean the mortar from the top course of brick. Rebuild the manhole or inlet to the original top dimensions or to the dimensions shown on the plans. Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour.

3.31.2. **Raising the Top of a Manhole or Inlet**. Clean the top surface of brick or concrete. Construct to the proper new elevation using new brick, brick salvaged from other manholes or inlets, prefabricated metal extension rings, concrete rings, or Class A concrete. Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour. Install prefabricated extension rings in accordance with manufacturer's instructions.

4. MEASUREMENT

4.1. **Water Main Pipe and Steel Casing**. Measured by the foot of the various sizes and types specified. Water mains and casing will be measured along the axis of the pipe, and no deductions will be made for valves or fittings. Reducers will be classed as pipe of the size of the larger end.

Unless otherwise shown on the plans, fire hydrant branches (leads) will be measured by the foot of the various types and installation methods specified, along the axis of each branch (lead) from the hydrant to the end of the branch (lead). No deductions will be made for valves or fittings.

4.2. **Split Steel Casing**. Measured by the foot of the various sizes shown on the plans.

4.3. **FRP Pipe for Casing**. Measured by the foot of the various sizes shown on the plans.

4.4. **Jacking, Tunneling, Boring, or Augering**. Jacking, tunneling, boring, or augering for water mains and steel casing will be measured by the foot of the sizes, types, and wall thickness (applicable only for casing) specified.

Jacking, tunneling, boring, or augering for fire hydrant branches (leads) will be measured by the foot of the various types specified.

4.5. **New Copper Service Lines**. Measured by each service line installed.

Short-side service line refers to service connections made to meters located on the same side of the street as the supply main location. Long-side service line refers to service connections made to meters located on the opposite side of the street from the supply main, or from the center of the street, where the supply main is in the center of the street.

4.6. **Gate Valves, Tapping Sleeves and Valves, and Butterfly Valves**. Measured by each assembly installed of the various sizes specified, except that gate valves 20 in. in diameter and smaller will be included as part of the work to the water lines.

4.7. **Fire Hydrants**. Measured by each assembly installed, including a 6-in. gate valve and box, regardless of depth. It is the Contractor's responsibility to install the fire hydrant assembly such that it meets the standard installation requirements of this Specification and the manufacturer's specifications.

Fire hydrant branches (leads) will be measured as indicated in Section 4.1., "Water Main Pipe and Steel Casing," and Section 4.4., "Jacking, Tunneling, Boring, or Augering."

4.8. **Meters and Vaults**. Measured by each assembly constructed.

4.9. **Air Release and Vacuum Relief Valves**. Measured by each assembly of the various sizes, with the valve box installed.

4.10. **Pressure-Reducing Stations**. Measured by the lump sum unit constructed.

4.11. **Blowoff Valves**. Measured by each assembly of the various sizes and types, with the valve box installed.

4.12. **Removing Fire Hydrants**. Measured by each assembly removed and disposed of properly.

4.13. **Removing Water Valves and Boxes**. Measured by each assembly removed and disposed of properly.

4.14. **Removing and Relocating Meters and Boxes**. Measured by each assembly removed, cleaned, and installed at the new location.

4.15. **Removing Meters and Vaults**. Measured by each assembly removed and disposed of properly.

4.16. **Removing and Salvaging Water Meters**. Measured by each assembly removed and salvaged.

4.17. **Removing and Salvaging Fire Hydrants**. Measured by each assembly removed and salvaged.

4.18. **Removing and Relocating Water Meters and Meter Vaults**. Measured by each assembly removed and relocated.

4.19. **Adjusting Meter Vaults**. Measured by each assembly adjusted.

4.20. **Adjusting Meter Boxes**. Measured by each assembly adjusted.

4.21. **Adjust or Relocate Water Meter**. Measured by each assembly adjusted or relocated.

4.22. **Lowering Water Mains**. Measured by the foot of the sizes and types of pipe lowered.

4.23. **Cutting and Plugging Water Mains**. Measured by each location where a water main is cut and plugged, of the sizes indicated.

4.24. **Removing Pressure-Reducing Stations**. Measured by each complete pressure-reducing station removed.

4.25. **Wet Connections**. Measured by each connection of the sizes specified.

4.26. **Extra Hand Excavation or Extra Machine Excavation**. Measured by the cubic yard in its original position. Excavation performed by manual labor at the locations specifically designated by the Engineer, and that is not included under other bid items contained in this Specification, is considered extra hand excavation or extra machine excavation.

4.27. **Adjusting Manholes**. Adjusted manholes will be measured as each manhole adjusted.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the items of work described below. These prices are full compensation for furnishing, hauling, placing, and installing the materials; for inspecting and testing; and for other materials, labor, equipment, tools, and incidentals.

5.1. **Water Main Pipe and Steel Casing**. Payment for water main pipe and steel casing will be made at the unit price bid for "Water Main Pipe (Cast-Iron)," "Water Main Pipe (Steel)," "Water Main Pipe (Ductile Iron)," "Water Main Pipe (Copper)," "Water Main Pipe (Polyvinyl Chloride) (PVC)," and "Casing (Steel)" of the various sizes and types specified, installed by the open-cut method.

Unless otherwise shown on the plans or in the Specifications, excavating, disposing of unsuitable excavated material, backfilling, and the material for backfill for the complete installation of the water main system will be subsidiary to this bid item.

5.2. **Split Steel Casing**. Payment for split steel casing will be made at the unit price bid for "Split Steel Casing" of the various sizes specified, installed by the open-cut method.

5.3. **FRP Pipe for Casing**. Payment for FRP pipe for casing will be made at the unit price bid for "Fiberglass Reinforced Plastic (FRP) Pipe for Casing" of the various sizes specified.

5.4. **Jacking, Tunneling, Boring, or Augering**. Payment for jacking, tunneling, boring, or augering water main will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering (Water Main)" of the sizes and types specified. This price includes furnishing the pipe.

Payment for jacking, tunneling, boring, or augering fire hydrant branches (leads) will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering Fire Hydrant Branch (Lead) (6 in.)" of the types and installation method specified. This price includes furnishing the pipe.

Payment for jacking, tunneling, boring, or augering steel casing will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering Casing (Steel)" of the sizes, types, and wall thickness (applicable only if exceeding minimum thickness, shown in Section 2.2.2., "Steel Casing Pipe") specified. This price includes the casing. Water mains and fire hydrant branches (leads) placed in the casing will be paid for under the appropriate bid item.

Excavating; backfilling; backfill material; and disposing of unsuitable excavated material for jacking, tunneling, boring, or augering pits will be subsidiary to these bid items.

5.5. **New Copper Service Lines**. Payment for copper service lines will be made at the unit price bid for "Service Line (Short Side 5/8 in. to 1 in.)," "Service Line (Long Side 5/8 in. to 1 in.)," "Service Line (Short Side 1-1/2 in.

to 2 in.)," and "Service Line (Long Side 1-1/2 in. to 2 in.)" installed. This price is full compensation for labor, materials, excavation, and backfill required to install the facility, including connection to the customer's service line.

5.6. **Gate Valves, Tapping Sleeves and Valves, and Butterfly Valves**. Payment for gate valves (larger than 20 in. in diameter), tapping sleeves and valves, and butterfly valves will be made at the unit price bid for "Gate Valve," "Tapping Sleeve and Valve," and "Butterfly Valve" of the various sizes specified, with the valve box installed.

5.7. **Fire Hydrants**. Payment for fire hydrants will be made at the unit price bid for "Fire Hydrant Assembly," including 6-in. gate valve and box, installed regardless of barrel depth.

Payment for fire hydrant branches (leads) will be made at the unit price bid for "Fire Hydrant Branch (Lead) (6 in.)" installed by the open-cut method.

Any adjustment required either in the flow line of the water main or to the barrel length of the fire hydrant will be subsidiary to this bid item.

5.8. **Meters and Vaults**. Payment for meters and vaults will be made at the unit price bid for "Meter and Vault" constructed.

5.9. **Air Release and Vacuum Relief Valves**. Payment for air release and vacuum relief valves will be made at the unit price bid for "Air Release and Vacuum Relief Valve" of the various sizes specified, with the valve box installed.

5.10. **Pressure-Reducing Stations**. Payment for pressure-reducing stations will be made at the unit price bid for "Pressure Reducing Station." This price is full compensation for performing the necessary excavation, backfill, finish grading, constructing the concrete structure, and furnishing and installing station appurtenances addressed under Article 2., "Materials."

5.11. **Blowoff Valves**. Payment for blowoff valves with boxes will be made at the unit price bid for "Blow Off Valve" of the various sizes and types specified, with the valve box installed.

5.12. **Removing Fire Hydrants**. Payment for removing fire hydrants will be made at the unit price bid for "Removing Fire Hydrant." This price includes removing valves from the existing location, disposing of the valves, and plugging at the tee. Excavation and backfill required for removing fire hydrants will be subsidiary to this bid item.

5.13. **Removing Water Valves and Boxes**. Payment for removing water valves and boxes will be made at the unit price bid for "Removing Water Valve and Box." Excavation and backfill required for removing water valves and boxes will be subsidiary to this bid item.

5.14. **Removing and Relocating Meters and Boxes**. Payment for removing and relocating meters and boxes will be made at the unit price bid for "Removing and Relocating Meter and Box."

5.15. **Removing Meters and Vaults**. Payment for removing meters and vaults will be made at the unit price bid for "Removing Meter and Vault." This includes salvaging the meter strainers and valves and delivering them to their owner at the location shown on the plans or as directed.

5.16. **Removing and Salvaging Water Meters**. Payment for removing and salvaging water meters will be made at the unit price bid for "Removing and Salvaging Water Meter." This price includes removing salvaged water meters from the existing locations and delivering them to the owner. Excavation, backfill, and finish grading required for removing the water meters will be subsidiary to this bid Item.

5.17. **Removing and Salvaging Fire Hydrants**. Payment for removing and salvaging fire hydrants will be made at the unit price bid for "Removing and Salvaging Fire Hydrant." The salvaging of fire hydrants will be a cash reimbursement to the owner by the Contractor where the fire hydrants will become the property of the Contractor or the Contractor will deliver the fire hydrants to the utility owner at the location shown on the plans. Excavation, backfill, and finish grading required for removing fire hydrants will be subsidiary to this bid item.

5.18. **Removing and Relocating Water Meters and Meter Vaults**. Payment for removing and relocating water meters and meter vaults will be made at the unit price bid for "Removing and Relocating Water Meter and Meter Vault."

5.19. **Adjusting Meter Vaults**. Payment for adjusting meter vaults will be made at the unit price bid for "Adjusting Meter Vault." This price is full compensation for furnishing the required materials, including backfill as required; excavation; tools; labor; equipment; and incidentals.

5.20. **Adjusting Meter Boxes**. Payment for adjusting meter boxes will be made at the unit price bid for "Adjusting Meter Box."

5.21. **Adjust or Relocate Water Meter**. Payment for adjusting or relocating water meters will be made at the unit price bid for "Adjusting or Relocating Water Meters." This price is full compensation for adjusting or relocating water meters. Miscellaneous fittings required to complete the work will not be paid for directly, but will be subsidiary to this Item unless otherwise shown on the plans. Water line sterilization and testing of the completed water main system will be subsidiary to this Item.

5.22. **Lowering Water Mains**. Payment for lowering water mains will be made at the unit price bid for "Lowering Water Mains" of the sizes and types of pipe lowered. This price is full compensation for lowering and adjusting pipes, as well as any connected valves, boxes, and service lines. Excavation and backfill required for lowering water mains will be subsidiary to this bid item.

5.23. **Cutting and Plugging Water Mains**. Payment for cutting and plugging water mains will be made at the unit price bid for "Cut and Plug Water Main" of the sizes indicated. This price is full compensation for performing excavation, backfill, finish grading, and other incidental items required to abandon or cut and plug the water main as set forth in this Specification. Grout, where required as shown on the plans, will be subsidiary to this bid item.

5.24. **Removing Pressure-Reducing Stations**. Payment for removing pressure-reducing stations will be made at the unit price bid for "Removing Pressure Reducing Station." This price is full compensation for performing the necessary excavation; backfill; finish grading; pipe removal; structure removal; and tools, equipment, and incidentals.

5.25. **Wet Connections**. Payment for wet connections will be made at the unit price bid for "Wet Connections" of the sizes specified.

5.26. **Extra Hand Excavation or Extra Machine Excavation**. Payment for extra hand excavation or extra machine excavation will be made at the unit price bid for "Extra Hand Excavation" or "Extra Machine Excavation." This price is full compensation for labor, hand tools, machines, dewatering, and handling and properly disposing of any excess excavated material not suitable for bedding or backfill for this project.

5.27. **Adjusting Manholes**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (Adj Exist Manhole)." This price is full compensation for replacement of air release and vacuum release valve and installation of the standard bollards as shown on the plans; for materials including backfill as required; and for excavation, tools, equipment, labor, and incidentals.

Trench excavation protection or temporary special shoring for trenches greater than 5 ft. in depth, or sloping the sides of these trenches to preclude collapse, will be measured and paid for as required by Item 402 or Item 403.

Furnishing and placing bedding material will be subsidiary to the various bid items.

Providing fittings, including necessary concrete thrust blocking, pipe clamps, nipples, pipe coatings, and lubricants, will be subsidiary to the water mains in which they are installed.

In addition, providing fittings required due to plan changes or alterations in line and grade will be subsidiary to the water mains in which they are installed.

Furnishing and installing taps, risers, jumpers, blind flanges, cast iron sleeves, plugs, and reducers as required to disinfect and pressure-test the new mains will be subsidiary to the various bid items. In addition, necessary excavation and backfill, site grading, and maintenance until completion of pressure-testing will be subsidiary to the various bid items.

Unless otherwise shown on the plans, the work performed and materials furnished to support the pipes or conduits of public utilities will be subsidiary to the various bid items.

Furnishing and installing the nonmetallic pipe detection system, as well as the labor and materials necessary for the system, will be subsidiary to the various bid items. In addition, ensure that the detection system is complete, operational, and satisfactory to the utility owner.

Adjusting valve boxes will be subsidiary to the various bid items.

Special Specification 7019
Subsurface Utility Locate

1. DESCRIPTION

Perform Quality Level A to locate a subsurface utility facility as shown on the plans or as directed. Locate means to obtain precise horizontal and vertical position, material type, condition, size, and other data that may be obtainable regarding the utility facility and its surrounding environment through exposure by nondestructive excavation techniques that ensure the integrity of the utility facility. Subsurface utility locate Quality Level A is inclusive of Quality Levels B, C, and D.

Quality levels are defined by ASCE 38-02, "Standard Guideline for the Collection and Depiction of Existing Utility Data."

2. MATERIALS

Use materials that meet the requirements of the following Items.

- Item 132, "Embankment"
- Item 334, "Hot-Mix Cold-Laid Asphalt Concrete Pavement"
- Item 341, "Dense-Graded Hot-Mix Asphalt"
- Item 400, "Excavation and Backfill for Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 700, "Pothole Repair"

3. CONSTRUCTION

3.1. **Surface Locate**. Contact utility owner to verify location of the utility facility before beginning subsurface location.

3.2. **Subsurface Locate**. Provide the locate method and equipment to the Engineer before work begins. Excavate using a method that is nondestructive to the utility facility. Expose and verify, by survey, the precise location of the utility facility.

3.3. **Surface Marking**. For locates within an existing roadbed carrying traffic, furnish and install an aboveground marker directly above centerline of the utility facility. For locates outside an existing roadbed, furnish and install a 4-in. pipe directly above centerline of the utility facility. The pipe should be capped and extend from the top of the utility facility to 4 in. above the surface.

3.4. **Removing Pavement or Concrete**. Remove material as necessary to locate the utility facility. Ensure all loose materials are removed and only sound material is left in place. Increase the cut and restore area to remove loose materials.

3.5. **Backfill**.

3.5.1. **Outside Roadbed**. Backfill minor excavations outside the edges of a proposed roadbed with Type B embankment in accordance with Item 132. Place 4 in. of topsoil.

3.5.2. **Within Roadbed**. Backfill excavations within a proposed or existing roadbed with cement-stabilized backfill in accordance with Item 400. Replace pavement in accordance with Section 3.6., "Cutting and Restoring Within Roadbed," of this Specification.

3.6. **Cutting and Restoring Within Roadbed**. Saw-cut all edges for areas larger than 3 sq. ft.

3.6.1. **Flexible Pavement**. Perform work in accordance with Item 700. Hot-mix asphalt (HMA) must be placed at a depth equal to the existing depth of pavement structure. Place hot-mix cold-laid asphalt Type C for areas equal to or less than 3 sq. ft. Use HMA for areas greater than 3 sq. ft. HMA must be Type B with 2-in. Type D surface.

3.6.2. **Concrete Pavement**. Concrete must be placed at a depth equal to the existing depth of concrete pavement. Repair in accordance with Item 361, "Full-Depth Repair of Concrete Pavement." Repair using half depth for areas equal to or less than 10 sq. ft. Repair using full depth for areas greater than 10 sq. ft.

3.6.3. **Concrete**. Concrete must be placed at a depth equal to the existing depth of concrete. Place class of concrete in accordance with Item 421. Areas larger than 3 sq. ft. will require reinforcing bars equal to the adjacent concrete reinforcement with reinforcement doweled 12 in. into existing concrete.

3.7. **Locate Report**. Provide a report of the locate data to the Engineer. Provide survey data to the Engineer in Microsoft Excel or approved alternative. The data should include utility owner name, utility service type, conduit size, conduit type, number of conduits, station, offset, and elevation. The data should be provided for each utility conduit if multiple conduits for the same utility owner are at the locate site. All conduits for the same utility owner at the locate site should be located with data provided in the same report.

3.8. **Utility Damage**. If any damage results from an act or omission on the part of or on behalf of the Contractor, take corrective action to restore the damaged property to a condition similar or equal to that existing before the damage. Be responsible for any damage to the utility facility during the locating process. If damage occurs, the Engineer will stop work and notify the appropriate utility facility owner, the State, and appropriate regulatory agencies. The regulatory agencies include, but are not limited to, the Railroad Commission of Texas and TCEQ. The Engineer will not resume work until the utility facility owner has determined the corrective action to be taken. The Engineer will be liable for all costs involved in the repair or replacement of the utility facility.

4. MEASUREMENT

This Item will be measured by each utility facility locate for each utility owner. Each conduit for the same utility owner at the locate site will not be paid for individually. Different utility owners in the same location should be paid separately.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the various designations of "Subsurface Utility Locate."

This price is full compensation for utility coordination, surface location, excavation, embankment, removal of concrete and pavement, backfill material, topsoil, disposal of material, saw cutting, cutting and restoring pavement and concrete, survey, traffic control, barricades, equipment, labor, tools, and incidentals.

Special Specification 7033
Water Mains and Service Lines

1. DESCRIPTION

Provide and install a complete water main system as shown on the plans and Specifications and in accordance with the Department's Utility Accommodation Policy (43 TAC §§ 21.31–21.55). The water mains must be of the sizes, materials, and dimensions shown on the plans and must include all pipe, all joints and connections to new and existing pipes, all valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and other work, as may be required to complete the work.

The abbreviations AWWA, ASA, ASTM, ANSI, and NSF, as used in this Specification, refer to the following organizations or technical societies.

- **AWWA**. American Water Works Association.
- **ASA**. American Standards Association.
- **ASTM**. American Society for Testing and Materials.
- **ANSI**. American National Standards Institute.
- **NSF**. National Science Foundation.

Where reference is made to specifications of the above organizations, it is to be construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

All materials used in this project must be new and unused, unless otherwise specified on the plans, in the Specifications, or in the proposal.

2.1. **Ductile Iron Pipe (DIP) and Fittings**.

2.1.1. **DIP: 3 in.–64 in**. All DIP must be manufactured by process of centrifugal casting and be in accordance with AWWA C-151, "American Standard for Ductile-Iron Pipe Centrifugally Cast with Push-On or Mechanical Joints for Water or Other Liquids," unless otherwise specified.

Pipe must be in accordance with Table 1 to the following pressure classes based on Type 3 bedding conditions, a depth of bury of 6 ft., and a working pressure of 150 psi.

Table 1
Pipe Pressure Classes

Pipe Size (in.)	Pressure Class (psi)
3–12	350
16–20	250
24	200
30–64	150

Dimensions and tolerances for each nominal pipe size must be in accordance with Table 51.5 (push-on) or Table 51.5 (mechanical joint) of AWWA C-151 for pipe with a nominal laying length of 20 ft.

All pipe must have a standard water works cement mortar lining in accordance with AWWA C-104 with outside coating per Section 51.8.1 of AWWA C-151.

Exterior coating must consist of a nominal 1-mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA C-151.

Rubber joint gaskets used on DIP must be in accordance with AWWA C-111, latest revision.

Each length of pipe must bear identification markings in accordance with Section 51.10 of AWWA C-151.

Manufacturer must take adequate measure during pipe production to assure compliance with AWWA C-151 by performing quality control (QC) tests and maintain results of those tests as outlined in Section 51.14 of that standard.

The Engineer may, at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this Specification. Any visible defects or failure to meet quality standards are grounds for rejecting the pipe.

2.1.2. **Fittings for DIP**. Unless otherwise modified or supplemented, the latest revisions of AWWA C-110, "Ductile-Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids," and AWWA C-153, "Ductile-Iron Compact Fittings," govern the design, manufacture, and testing m all fittings under this Specification.

For 3-in.–24-in. size range, the pressure rating (PR) of all fittings must be a minimum of 250 psi. The working pressure for all fittings of sizes greater than 24 in. must be a minimum of 150 psi unless a change in PR is shown on the plans.

Fittings must be furnished with the type of end combination specified.

Mechanical joint (MJ) fittings and anchor-type fittings must be furnished complete, with glands, gaskets, and bolts. Bolts for MJs must be ASTM A536, specially alloyed, and heat-treated ductile iron (DI) in accordance with ANSI/AWWA C III/A 21.IL.

Flanged fittings must be faced and drilled in accordance with ASA B 16.1, Class 125.

Anchor fittings must be furnished in size and type or length as specified.

The exterior of all fittings must be provided with a petroleum asphaltic coating in accordance with AWWA C-110. The interior of flanged fittings supplied under this Specification must be either cement-mortar lined in accordance with AWWA C-104 or lined with a petroleum asphaltic material in accordance with the latest revision of AWWA C-110 as specified. The interior of all other fittings supplied under this Specification must be cement-mortar lined in accordance with the latest revision of AWWA C-104.

Fittings for 2-in. size must be manufacturer's standard design, designed in accordance with applicable design standard of AWWA C-110.

2.2. **Concrete Steel Cylinder Pipe and Fittings: 20 in. and Larger.** The design, component materials, manufacture, and testing of all concrete steel cylinder pipe and fittings must be in accordance with AWWA C-301, "Pre-Stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids." Except where otherwise shown in the Contract documents, all pipe must be AWWA, Class 150, and be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6 ft. of earth cover. Where the depth of bury of the pipe is shown to be greater than 6 ft. in the Contract Specifications or on the drawings, the design of the pipe must suitable for the earth loads shown.

All data submitted by the Contractor must include a tabulated layout schedule with reference to the stationing and grade lines shown on the plans. The Contractor must provide a design summary for each size of pipe furnished for each pressure and depth of bury.

Each special length of straight pipe must have plainly marked on the inside of the bell end the class of pipe and enough identification marks to show the proper location of the pipe by reference to layout drawings.

Pipe 20 in.–42 in. in size must be furnished in nominal lengths of 20 ft.–32 ft.; pipe 48 in.–72 in. in size must be furnished in nominal lengths of 16 ft. except as this requirement is to be modified by design requirements of the particular job.

Each joint of pipe must be furnished with a rubber gasket and a 12-in. diaper.

2.3. **Steel Pipe, Fittings, and Flanges**.

2.3.1. **Steel Pipe**. Steel pipe with nominal diameters from 6 in.–20 in. must be in accordance with ASTM A106; A53, Grade B; or A139, Grade B, standard weight class as the minimum.

Steel pipe greater than 20 in. must be in accordance with AWWA C-200, “Steel Water Pipe 6 in. (150 mm) and Larger,” and AWWA M-11, except as modified or as required for special circumstances.

Pipe must be designed for a minimum of 150-psi working pressure with an additional 50% of the working pressure allowance for surge pressure unless otherwise specified. Pipe design must be in accordance with AWWA M-11.

Pipe must be designed to cover conditions as shown on the plans. The design for deflection must be in accordance with AWWA M-11.

Pipe for use with sleeve-type couplings must have plain ends at right angles to the axis.

Pipe ends must be beveled and suitable for field butt welding except as otherwise specified.

Protective coatings and linings must be in accordance with AWWA C-203, “Coal-Tar Protective Coatings and Linings for Steel Pipelines—Enamel and Tape Hot Applied.”

Pipe length must be nominal 50-ft. lengths except for specials or as otherwise specified on the plans. Manufacturer must prepare a lay schedule showing the location of each piece by a mark number with station and invert elevation at each bell end.

2.3.2. **Fittings for Steel Pipe**. Unless otherwise shown on the plans, all specials and fittings must be in accordance with the dimensions of AWWA C-208, “Dimensions for Fabricated Steel Water Pipe.” Pipe material used in fittings must be of the same material and thickness as the pipe. The minimum radius of elbows must be 2-1/2 times the pipe diameter and the maximum miter angle on each section of the elbow must not exceed 11.25° (one cut elbow up to 22.5°). If elbow radius is less than 2-1/2 × pipe diameter, stresses must be checked per AWWA M-11 and wall thickness or yield strength increased if necessary. Fittings must be equal in pressure design strength. Specials and fittings, unless otherwise shown on the plans, must be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe must be checked per the requirements of AWWA C-200, Section 5.2.2.1.

2.3.2.1. **Rolled-Groove Rubber Gasket Joint**. The standard joint must be rolled-groove rubber gasket joint unless otherwise noted on the plans. Rolled-groove rubber gasket joints must be in accordance with AWWA C-200 and as shown in Chapter 8 of AWWA M-11.

The O-ring rubber gasket must have enough volume to approximately fill the area of the groove and must be in accordance with AWWA C-200.

The joint must be suitable for a safe working pressure equal to the class of pipe furnished and must operate satisfactorily with a deflection angle, the tangent of which must not exceed 1.00/D, where D is the outside diameter (OD) of the pipe in inches with a pull-out of 1 in.

Rolled-groove rubber gasket joints may be furnished only by a manufacturer that has furnished pipe with joints of similar design for comparable working pressure. Pipe diameter, pipe length, and wall thickness must have been in successful service for a period of at least 5 yr.

2.3.2.2. **Lap Weld**. Lap field-welded joints must be used where tied joints are shown on the plans. The standard bell must provide for a 2-1/2 in. lap. The minimum lap must be 1 in. The design maximum joint deflection or offset must be a 1-in. joint pull.

2.3.2.3. **Mechanical Couplings**. Mechanical couplings where shown on the plans must be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc, or equal. Insulating mechanical couplings where shown on the plans must be double-insulated Smith Blair Style 416, Baker Style 216, or equal. Mechanical couplings must be rated to meet or exceed the working pressures and surge pressure of the pipe.

Couplings for buried service must have all metal parts painted with epoxy paint and be in accordance with AWWA C-219.

Pipe ends for mechanical couplings must be in accordance with AWWA C-200 and AWWA M-11. The shop-applied outside coating must be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings.

Harness lugs or rings and pipe ends must be painted with one shop coat of epoxy in accordance with AWWA C-210. The inside lining must be continuous to the end of the pipe.

2.3.3. **Steel Flanges**. Steel pipe flanges, where shown on the plans, must be:

- in accordance with AWWA C-207, “Steel Pipe Flanges,” for Class D for operating pressures to 175 psi on 4 in.–12 in. diameter, and operating pressures to 150 psi on diameters more than 12 in.;
- AWWA C-207, Class E, for operating pressures up to 275 psi; or
- AWWA C-207, Class F, for pressures to 300 psi (drilling matches ANSI B 16.5, Class 250).

Shop lining and coating must be continuous to the end of the pipe or back of the flange. Flange faces must be shop coated with a soluble rust-preventive compound.

Gaskets must be full-face, 1/8-in. thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777, or equal.

Bolts for flanges located indoors and in enclosed vaults and structures must be carbon steel, ASTM A307, Grade B, for Class B and Class D flanges, and nuts must be ASTM A563, Grade A, heavy hex. Bolts for Class E and Class F flanges must be ASTM A193, Grade B7, and nuts must be ASTM A194, Grade 2 H, heavy hex.

Bolts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures must be Type 316 stainless steel in accordance with ASTM A193, Grade B8M, Class 1, for Class B and Class D flanges with ASTM A194, Grade 8M, nuts. For Class E and Class F flanges, the bolts must be ASTM A194, Grade 2H, nuts with bolt and nuts to be zinc plated in accordance with ASTM B633.

2.3.4. **Linings and Coatings**.

2.3.4.1. **Polyethylene Tape Coating**.

2.3.4.1.1. **Prefabricated Multi-Layer Cold-Applied Tape Coating**. The coating system for straight-line pipe must be in accordance with AWWA C-214. The system must consist of three layers of polyethylene material with a nominal thickness of 80 mils when complete.

2.3.4.1.2. **Coating Repair**. Coating repair must be made using tape and primer in accordance with AWWA C-209, Type II. The tape and primer must be compatible with the tape system used for straight-line pipe.

2.3.4.1.3. **Coating of Fittings, Specials, and Joints**. Fittings, specials, and joints that cannot be machine coated in accordance with Section 7033.2.3.4.1.1., "Prefabricated Multi-Layer Cold-Applied Tape Coating," must be coated in accordance with AWWA C-209. Prefabricated tape must be Type II and must be compatible with the tape system used for straight-line pipe. The system must comprise three layers consisting of alternate coating methods for fittings, specials, and field joints (shrink sleeves per C-216, or paint per C-210, C-218, or C-222). The field coating must completely encapsulate the joint bonds on O-ring joints.

2.3.4.1.3.1. **Coating Repair**. Coating repair for fittings and specials must comply with the procedure described in Section 7033.2.3.4.1.2., "Coating Repair," for straight-line pipe and as recommended by the manufacturer.

2.3.4.2. **Other Coating Systems**. Other coating systems if specified must be governed by the appropriate AWWA standard.

2.3.4.3. **Cement Mortar per AWWA C-205**.

2.3.4.3.1. **Cement Mortar Lining of Steel Pipe**.

2.3.4.3.1.1. **Cement-Mortar**. Except as otherwise provided in AWWA C-205, interior surface of all steel pipe, fittings, and specials must be cleaned and lined in the shop with cement-mortar lining applied centrifugally in accordance with AWWA C-205.

2.3.4.3.1.2. **Pipe Ends**. The pipe ends must be left bare where field joints occur as shown on the plans. Ends of the linings must be left square and uniform. Feathered or uneven edges are not permitted.

2.3.4.3.1.3. **Defective Linings**. Defective linings as identified in AWWA C-205 must be removed from the pipe wall and must be replaced to the full thickness required. Defective linings must be cut back to a square shoulder to avoid feather-edged joints.

2.3.4.3.1.4. **Storage and Shipping**. Cement-mortar lining must be kept moist during storage and shipping.

2.3.4.3.2. **Fittings**. Fittings must be lined and coated per AWWA C-205.

2.3.5. **Steel Casing Pipe**. The component materials, manufacture, and testing of all steel pipe must be in accordance with AWWA C-200, "Steel Water Pipe 6 in. and Larger." The specified pipe size must be the actual inside diameter (ID) of the pipe, special, or fitting in inches. The diameter and wall thicknesses of all steel pipe must conform to those shown on the plans.

Pipe must be either Grade A or Grade B, in accordance with ASTM A53.

Pipe ends must be beveled and suitable for field butt welding, except as otherwise specified.

Pipe must receive a protective coating in accordance with AWWA C-203.

Pipe length must be nominal 40-ft. lengths, except for specials or as otherwise specified on the plans. Standard and specials must be within ±1/16 in. of the specified or theoretical lengths.

2.3.6. **Stainless Steel Casing Spacer**. The casing spacers must be constructed of T-304 stainless steel segments that bolt together, forming a shell around the carrier pipe. The spacers must be designed with risers (when

needed) and runners to support the carrier within the casing and maintain a minimum clearance of 0.50 in. between the casing ID and the spacer OD. On carrier pipes with an OD less than 16 in., each spacer must have four riser and runner combinations, two on each segment. On carrier pipes with an OD of 16 in. and larger, each spacer must contain six riser and runner combinations, four on the bottom segment and two on the top segment. T-304 stainless steel bolts and nuts must be supplied with the spacers.

The band must be manufactured of 8-in. wide, 14-gauge, T-304 stainless steel material. The risers must be constructed of 10-gauge, T-304 stainless steel, with a minimum length of 6 in.

Abrasion-resistant runners, with a minimum length of 7 in. and a minimum width of 1 in., must be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material must be of glass-reinforced plastic with compression strength of 25,000 psi, flexural strength of 32,000 psi, and tensile strength of 22,000 psi. The ends of all runners must be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular steel shell must be lined with polyvinyl chloride (PVC) or ethylene propylene diene monomer (EPDM) with a minimum thickness of 0.090 in., with a hardness of Durometer “A” 85-90.

Spacers must be placed a maximum of 1 ft. on each side of the bell joint and every 8 ft.–12 ft. apart thereafter.

2.3.6.1. **Physical Properties**.

2.3.6.1.1. **Band and Risers**.

- **Band**. 14-gauge, T-304 stainless steel.
- **Riser**. Minimum 14-gauge, T-304 stainless steel.

2.3.6.1.2. **Liner—EPDM or PVC**.

- **Thickness**. 0.090 in. minimum.
- **Hardness**. Durometer “A” 85-90.
- **Dielectric Strength**. 1/8 in. thick.
- **Varying Permeability Model**. 60,000.
- **Water Absorption**. 1% maximum.
- **Edges**. Overlap.

2.3.6.1.3. **Studs, Nuts, and Washers**.

- **Studs**. T-304 stainless steel, 5/16 in., 18 in. × 2 in.
- **Nuts**. 5/16-in. hex.
- **Washers**. 5/16-in. Society of Automotive Engineers (SAE) 2330.

2.3.6.1.4. **Runners**. 1-in. wide or 2-in. wide glass-filled polymer runners.

- Sizes available:
  - **Length**. 7 in.
  - **Effective Heights (All Lengths)**. 1 in. and 1-1/2 in.
- Materials specifications:
  - **Tensile Strength (ASTM D638)**. 22,000 psi.
  - **Flexural Strength (ASTM D790)**. 32,000 psi.
  - **Compression Strength (ASTM D695)**. 25,000 psi.
  - **Deflection Temperature @ 264 psi (ASTM D648)**. 435°F (224°C).
  - **Deformation Under Load @ 122°F (50°C), 4,000-lb. Load (ASTM D648)**. 1.2%.

2.3.6.1.5. **Welding**. All risers must be welded by metal inert gas welding. Welds must be fully passivated.

2.3.7. **Quality Assurance (QA) Commercial Standards**. All manufacturing tolerances referenced in the below standards apply unless specifically excluded.

- ANSI/AWWA C-200, “Steel Water Pipe 6 in. and Larger”
- ANSI/AWWA C-205, “Cement-Mortar Protective Lining and Coating for Steel Water Pipe: 4 in. and Larger-Shop Applied”
- ANSI/AWWA C-206, “Field Welding of Steel Water Pipe”
- ANSI/AWWA C-207, “Steel Pipe Flanges for Water Works Service, 4 in.–144 in.”
- ANSI/AWWA C-208, “Dimensions for Fabricated Steel Water Pipe Fittings”
- ANSI/AWWA C-209, “Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines”
- ANSI/AWWA C-210, “Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines”
- ANSI/AWWA C-214, “Tape Coating Systems for the Exterior of Steel Water Pipelines”
- ANSI/AWWA C-216, “Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines”
- ANSI/AWWA C-218, “Liquid Coating the Exterior of Aboveground Steel Water Pipelines and Fittings”
- ANSI/AWWA C-219, “Bolted Sleeve-Type Couplings for Plain-End Pipe”
- ANSI/AWWA C-222, “Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings”
- AWWA M-11, “Steel Pipe: A Guide for Design and Installation”
- ASTM A106, “Seamless Carbon Steel Pipe for High-Temperature Service”
- ASTM A53, “Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless”
- ASTM E165, “Method for Liquid Penetrant Examination”
- ASTM E709, “Guide for Magnetic Particle Examination”
- ASME Section V, “Nondestructive Testing Examination”
- ASME Section IX, “Welding and Brazing Qualification”
- AWS B 2.1, “Welding Procedure and Welding Qualifications”

2.3.8. **Qualifications**. The pipe and fittings must be designed, constructed, and installed in conformance with the best practices and methods and must be in accordance with these Specifications as applicable.

Pipe must be the product of one manufacturer. All pipe manufacturing, including cylinder production, lining, coating, and fittings, must be produced by one manufacture. The pipe manufacturer must have a certified QA program. This certified program must be ISO 9001:2000 or other equivalent nationally recognized program.

2.4. **PVC Pipe and Fittings**.

2.4.1. **PVC Pipe, 4 in.–12 in**. PVC pressure pipe, 4-in.–12-in., must be made from Class 1245A or Class 1245B compounds as determined by ASTM D1784 and providing for a hydrostatic design basis (HDB) of 4,000 psi.

All PVC pipe must be in accordance with AWWA C-900, “Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.–60 In. (100 mm–1,500 mm).” The manufacturer must supply the Engineer an affidavit that the materials supplied comply with all applicable requirements of AWWA.

All AWWA C-900 PVC pipe must have a PR of 150 psi and a dimension ratio (DR) of 18 with cast-iron equivalent ODs unless otherwise specified. It must have a sustained pressure requirement of 500 psi and a minimum burst pressure of 755 psi. AWWA C-900 PVC pipe installed in high-pressure zones must have a PR of 200 psi and a DR of 14, a sustained pressure requirement of 650 psi, and a minimum burst pressure of 985 psi. It must be furnished in nominal 20-ft. lengths and must be self-extinguishing.

Dimensions and tolerances for each nominal pipe size must be in accordance with Section 2.2, Table 1, of AWWA C-900.

Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket must be designed with a retainer ring that locks the gasket into integral bell groove and must be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC pipe must meet requirements provided in ASTM D3139 and ASTM D2122. The gasket must be reinforced with a steel band and must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings in accordance with Section 2.6 of AWWA C-900.

2.4.2. **PVC, 14 in.–36 in.**

2.4.2.1. **Scope**. This product Specification covers 14-in. nominal diameter–36-in. nominal diameter PVC potable water transmission pipe with integral bell and spigot joints. The pipe must be extruded from Class 12454-A or Class 12454-B PVC compound as defined in ASTM D1784, and provide for an HDB of 4,000 psi. The pipe ODs must conform to dimensions of cast iron pipe (CIP). All pipe furnished must be in accordance with AWWA C-905-97.

Pipe must be homogenous throughout. It must be free of voids, cracks, inclusions, and other defects. It must be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces must be free of nicks and scratches. Joining surfaces of spigots and joints must be free of gouges and imperfections that could cause leakage.

2.4.2.2. **Definitions**. All definitions are defined in accordance with AWWA C-905-97, Section 1.2, “Definitions.”

- **DR**. The ratio of the pipe OD to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary.
- **PR**. The nominal PR of transmission pipe is determined from formulas in Section 5, “Transmission-Pipe Ratings,” of AWWA C-905-97 using a safety factor of 2.0. There is no allowance for surge pressure in the PR.

2.4.2.3. **General**. Except as noted on the plans or in procurement Specifications for specific jobs, all C-905 PVC pipe must have a PR of 235 psi and a DR of 18, or have the highest PR available for each size of pipe.

Dimensions and tolerances for each nominal pipe size must be in accordance with Table 2, “Dimensions for PVC Transmission Pipe with CI Outside Diameter,” of Section 3, “Pipe Requirements,” in AWWA C-905-97. All pipe must be suitable for use as a pressure conduit.

Pipe must be gauged full length and furnished in standard laying lengths of 20 ft. ±1 in. unless otherwise noted. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket must be designed with a retainer ring that locks the gasket into integral bell groove and must be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC transmission pipe must meet requirements provided in ASTM D3139 and ASTM D2122. The gasket must be reinforced with a steel band and must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings that must remain legible after normal handling, storage, and installation. Markings must be applied in a manner that must not weaken or damage the pipe. Markings must be applied at intervals of no more than 5 ft. on the pipe. The minimum required

markings are given in the list below. Marking requirements are in accordance with Section 4.7, "Marking Requirements," of AWWA C-905-97.

- Nominal size and OD base (e.g., 24 cast iron [CI])
- PVC
- DR (e.g., DR 25)
- AWWA PR (e.g., PR 165)
- AWWA designation number for this standard (AWWA C-905)
- Manufacturer's name or trademark
- Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture

2.4.3. **AWWA C-900 and AWWA C-905 Requirements**. Bundle pipe in pallets for ease of handling and storage. Package pipe bundles to provide structural supports to ensure that weight of upper units does not cause deformation to pipe in lower units.

Pipe bundles showing evidence of ultraviolet (UV) radiation "sunburn" on exposed pipe, as may be caused from extended unprotected storage conditions, will not be accepted.

The pipe must be in accordance with AWWA C-900 or AWWA C-905-97 as applicable by performing QC-control tests and maintaining results of those tests as outlined in Section 3 of that standard. Submission of product constitutes certification of compliance with standard.

Pipe is intended for use as an underground, direct-bury pressure pipe for transport of potable water. The expected life of pipe system after installation is 25 yr.–50 yr.

Provide a 1-yr. warranty for all material sold and delivered for use and incorporation into water system. Warranty must take effect on the date that pipe is accepted by the Department.

Provide user reference and claims history for further investigation before the Engineer renders final decision on the acceptance of product furnished.

2.4.3.1. **Approved Manufacturers**. Table 2 identifies the approved manufacturers and products for C-900 PVC pressure pipe for 4 in.–12 in.

Table 2
Approved Manufacturers for C-900 PVC Pressure Pipe, 4 in.–12 in.

Manufacturer	Type
PW Eagle	C-900 PVC
J-M Manufacturing Company	C-900 PVC
Certain Teed Corporation	C-900 PVC
Diamond Plastics Corporation	C-900 PVC Lok-21 PVC
North American Pipe Corporation	C-900 PVC
VinylTech Corporation	C-900 PVC
JM Eagle	C-900 PVC
Northern Pipe Products, Inc.	C-900 PVC
Underground Solutions	Fusible C-900 PVC
Pipelife Jet Stream	C-900 PVC

2.4.3.2. **Test**. For both C-900 and C-905, water system may, at no cost to manufacturer, subject random lengths of pipe for testing by an independent laboratory in accordance with this Specification. Any visible defects of failure to meet quality standards herein are grounds for rejecting entire order.

For C-905, the manufacturer must pressure test all pipe, including the joint, which is marked with the designation number of AWWA C-905-97 at 73.4ºF ±3.6ºF (23ºC ±2ºC). Each length of pipe must be proof

tested at twice the PR listed in Table 3, “Transmission-Pipe Pressure Rating,” of AWWA C-905-97, Section 4.6, “Pressure Strength and Hydrostatic Proof.”

2.4.3.2.1. **References**. The documents listed below are referenced in this Specification.

- AWWA C-905-97, “Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14 in. Through 36 in.”
- ASTM D1784, “Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds”
- ASTM D2122, “Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings”
- ASTM D3139, “Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals”
- ASTM F477, “Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe”

2.4.4. **Bends and Fittings for PVC Pipe 4 in.–36 in**. All bends and fittings must be in accordance with the same requirements in Section 7033.2.1.2., “Fittings for DIP.”

2.4.5. **Joint Restraint System for PVC C-900/C-905**.

2.4.5.1. **Scope**. This Specification covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4 in.–12 in. in diameter and PVC C-905 pipe sizes 16 in.–24 in. diameter, and for DIP sizes 4 in.–24 in. in diameter.

Joint restraint systems are classified as “compression,” “MJ,” or “non-metallic restrained joint” for the specific type of pipe joint to be restrained.

General Requirements. UL and Factory Mutual (FM) certifications are required on all restraint systems.

Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe must meet or exceed ASTM F1674-96, “Standard Test Methods for Joint Restraint Products for Use with PVC Pipe,” or the latest revision thereof. Restraint systems used on ductile pipe must meet or exceed UL 194.

Non-metallic restrained joint pipe and couplings must be used specifically for C-900 PVC pipe and fittings in sizes 4 in.–12 in.

Each restraint system must be packaged individually and include installation instructions.

2.4.5.2. **Specific Requirements**.

2.4.5.2.1. **Restrainer for PVC C-900 and C-905 and DI Push-On Type Connections**. Pipe restraints must be used to prevent movement for push-on DI or PVC (C-900 and C-905) (compression-type) bell and spigot pipe connections, or where a transition or flexible coupling has been used to join two sections of plain end pipe DI or PVC (C-900 and C-905). The restrainer may be adapted to connect a plain end DI or PVC pipe to a DI MJ bell fitting. The restrainer must not be directionally sensitive.

The pipe must be restrained by a split retainer band. The band must be cast DI meeting or exceeding ASTM A536-80, Grade 65-45-12. The inside face or contact surface of the band must be of enough width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration must provide full (360°) contact, maintain pipe roundness, and avoid any localized points of stress. The split band casting must be designed to “bottom out” before clamping bolt forces (110-ft. lb. minimum torque) can overstress the pipe but must provide full non-directionally sensitive restraint at the rated pressures.

Bolts and nuts used to attach the split retainer ring must be in accordance with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts, and restraining rods must be fabricated from high-strength, low-alloy steel per AWWA C-111-90 and ANSI/AWWA C-111/A-21.11.

The split-ring type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Section 7033.2.4.5.2.4., “Fitting Restraint for DIP (Only),” and be for both DI and PVC C-900.

Restraint systems sizes 6 in.–12 in. must be capable of use for both DI and PVC C-900.

The restraint system may consist of two types: the two split retainer rings and for new construction use only, the one split and one solid cast backup ring.

2.4.5.2.2. **Compression Ring Fitting Restrainer for DIP and PVC C-900**. Compression ring with follower-gland type of restrainer may be used in conjunction with MJ bell end DIP fittings for restraining PVC C-900 and DIP.

The system must use a standard MJ gasket with a color-coded compression ring and replacement gland in accordance with ASTM A536-80, Grade 65-45-12.

Standard MJ fitting tee-bolts and nuts must be fabricated from high-strength steel in accordance with ANSI/AWWA C-111/A-21.11 and AWWA C-153/A-21.53-88.

Standard MJ gasket must be virgin styrene-butadiene rubber (SBR) meeting ASTM D2000 3 BA 715 or ASTM D2000 3 BA 515.

The restraint system must be capable of a test pressure twice the maximum sustained working pressure listed in Section 7033.2.4.5.2.4., “Fitting Restraint for DIP (Only).”

2.4.5.2.3. **Non-Metallic Restrained Joint Pipe and Couplings for PVC C-900 Type Connections**. Gasketed restrained coupling connections must join two sections of factory-grooved PVC C-900 pipe. The restrainer coupling must not be directionally sensitive.

The coupling must incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477 and must be DR-14 Class 200 C-900 PVC in all applications, meeting or exceeding the performance requirements of AWWA C-900, latest revision. The inside face or contact surface of the coupling connection must be of enough width to incorporate a factory-machined non-directionally sensitive groove in both pipe and coupling to grip the outside circumference of the pipe. The couplings must provide full (360°) contact, maintain pipe roundness, and avoid and localized points of stress. The coupling must be designed with an internal stop to align the precision-machined grooves in the coupling and pipe before installation of a non-metallic thermoplastic restraint spleen and must provide full non-directionally sensitive restraint at the rated pressures.

High-strength flexible thermoplastic spleens must be inserted into mating precision-machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

The non-metallic restrained joint pipe and couplings for PVC C-900 type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Section 7033.2.4.5.2.4., “Fitting Restraint for DIP (Only),” and be for PVC (C-900) pipe sizes 4 in.–12 in.

Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes 4 in.–12 in. must be capable of use for both Class 150 (DR-18) and 4 in.–8 in. for Class 200 (DR-14) PVC C-900 pipe.

The non-metallic restrained joint pipe and couplings for PVC C-900 restraint system must consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of FM and UL.

2.4.5.2.4. **Fitting Restraint for DIP (Only)**. Radial-bolt type restrainer systems must be limited to DIP in conjunction with MJ bell end pipe of fittings. The system must use a standard MJ gasket with a DI replacement gland in accordance with ASTM A536-80. The gland dimensions must conform to MJ bolt circle criteria.

Individual wedge restrainers must be DI heat treated to a minimum hardness of 370 Brinell hardness number. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to ensure proper actuating of the restraining system.

Standard MJ fitting tee-bolts and nuts must be high-strength steel in accordance with AWWA C-111/A 21.11 and AWWA C-153/A 21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D2000 3 BA 715 or ASTM D2000 3 BA 515.

2.4.5.2.5. **Maximum Sustained Working Pressure Requirement**. Maximum sustained working pressure requirement is presented in Table 3.

Table 3
Maximum Sustained Working Pressure Requirement

Nominal Diameter (in.)	PVC C-900/C-905 (psi)	DI (psi)
4 and 6	200	350
8	200	250
10 and 12	200	200
14 and 16	200/235	200
20 and 24	200/235	200

2.4.5.2.6. **Tests**. The Engineer may, at no cost to the Contractor, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards is grounds for rejecting the entire order.

2.4.5.2.7. **Product List**. Other approved equal products from other manufacturers meeting these Specifications may be submitted for review.

2.4.5.2.7.1. **Slip-On Joint Restraint Systems**. Slip-on joint restraint systems are listed in Table 4.

Table 4
Slip-On Joint Restraint Systems

Manufacturer	PVC C-900/C-905	DI	DI (16" Above)
Ford/Uni–Flange Corporation	Series 1390C	Series 1390C	1390C
EBBA Iron Sales, Inc.	1500	1700	1700
Romac Industries, Inc. 4–8 in.	Model 611	Model 611	47 OSJ
Star Pipe Products	1100	1100	1100
Tyler Union	3000	3000	3000
Sigma Corporation	PV–LOK (PVP)/PTP	PV–LOK (PVP)/PTP	SLDH SLDH

2.4.5.2.7.2. **Compression Ring Systems**. Compression ring systems are listed in Table 5.

Table 5
Compression Ring Systems

Manufacturer	PVC C-900	DI
Romac Industries, Inc.	Grip Ring-DI	Grip Ring-DI
Tyler Corporation	MJR Gland	MJR Gland
Star Pipe Products	Ring Lock 3500 Series	–

2.4.5.2.7.3. **Non-Metallic Restrained Joint Pipe and Couplings for PVC C-900 Restrain-Joint (RJ) Type Connections**. Non-metallic restrained joint pipe and couplings for PVC C-900 RJ-type connections are listed in Table 6.

Table 6
Non-Metallic Restrained Joint Pipe and Couplings for PVC C-900 RJ-Type Connections

Manufacturer	PVC C-900 (in.)	DI
CertainTeed Corporation, Certa-Lok C-900/RJ	4–12	Class 150 (DR-18)
	4–8	Class 200 (DR-14)

2.4.5.2.7.4. **Fitting Restraints (MJ)**. Fitting restraints (MJ) are listed in Table 7.

Table 7
Fitting Restraint (MJ)

Manufacturer	PVC C-900	DI
EBBA Iron Sales, Inc.	2000 PV	MEGALUG 1100
Romac Industries, Inc.	Not approved	Not approved
Ford/UniFlange	UFR-1500-C 4"–24"	Series 1400
Star Pipe Products	Stargrip 4000	Stargrip 4000
Sigma Corporation	One Lok SLC	One Lok SLD
Tyler Union	TUFGRIP 2000F	TUFGRIP 1000F

2.4.5.2.7.5. **Restrained Flange Adapters**. Restrained flange adapters are listed in Table 8.

Table 8
Restrained Flange Adapters

Manufacturer	PVC C-900	DI
EBBA Iron Sales, Inc.	2100 Megaflange	2100 Megaflange
Ford/UniFlange	900	200, 400, 420

2.5. **Copper Tubing and Brass Fittings for Copper Service Lines**.

2.5.1. **Copper Tubing**. All 3/4-in., 1-in., 1-1/2 in., and 2-in. copper tubing for underground service must be of the type commercially known as Type “K” soft and in accordance with ASTM B88 and NSF 61.

Copper tubing 3/4 in. and 1 in. must be furnished in 60-ft. coils or 100-ft. coils as specified; 1-1/2 in. must be furnished in 20-ft. lengths, 40-ft. coils, or 60-ft. coils as specified; and 2 in. must be furnished in 20-ft. lengths or 40-ft. coils as specified.

2.5.2. **Brass Fittings**.

2.5.2.1. **General**. Water works brass goods consisting of corporation stops, curb stops, couplings, connectors, and nipples are required in underground installations of service lines in the water distribution system, unless otherwise modified.

The brass composition must be in accordance with ASTM B62, and the threads must be in accordance with AWWA C-800-01, “Threads for Underground Service Line Fittings.”

All casting must have a natural, clean, uniform, and smooth surface and be free of internal porosity.

All machining must be completed in a workmanlike manner and within the acceptable tolerances.

Unless otherwise specified, each fitting must be furnished with a 1/16-in. thick fiber gasket.

2.5.2.2. **Design Criteria for Curb Stop and Angle Valves Ball Type**. All curb stop, corporation, and angle valves must be ball valves. “Inverted/Ground Key”-type angle valves will not be accepted.

Ball angle valves must not have a stop.

Laying dimensions must be the same as present inverted key style or equal to Mueller H-14258.

Reduced port design is acceptable provided there is no compromise on flow capacity compared to the "Inverted/Ground Key"-type angle valve.

Pack joints are not acceptable.

2.5.2.2.1. **Manufacturer Lists**. Approved manufacturers for in-line female iron pipe (FIP) × FIP, angle curb stop meter coupling × compression, FIP × meter swivel nut and coupling, and ball corporation valve are listed in Tables 9, 10, 11, and 12, respectively.

Table 9
2-in. FIP × FIP

Manufacturer	Model
Ford Meter Box	B11777WR
A.Y. McDonald	6111W
Mueller	B-20200-3
James Jones	J1900

Table 10
Angle Curb Stop Meter Coupling × Compression

Manufacturer	Size			
	3/4"	1"	1.5"	2"
A.Y. McDonald	4652BQ	4652BQ	–	4612BQ
Ford Meter Box	BA43-232WRQ	BA43-344WRQ	BFA43-666WRQ	BFA43777WRQ
Mueller	B24258-R3	B24258-3	B24276-3	B24276-3
James Jones	J1963WSG	J1963WSG	J1975WSGLS	J1975WSGLS
Hays	2520CGJ-R	–	–	–

Table 11
FIP × Meter Swivel Nut and Coupling

Manufacturer	Size
	3/4"
A.Y. McDonald	4654B
Ford Meter Box	BA13232WR
Mueller	B24265-R3
James Jones	J-1966WLS
Hays	2521-R

Table 12
Ball Corporation Valve

Manufacturer	CC × CMP	IP × CMP
A.Y. McDonald	4701BQ	4701BQ
Mueller	B-25008	B-25008
James Jones	1937 SG	1937 SG
Ford Meter Box	FB-1000Q	FB-1000Q

2.6. **Gate Valves, Tapping Valves, and Tapping Sleeves**.

2.6.1. **Gate Valves**.

2.6.1.1. **General**. Except as otherwise specified, AWWA C-509-01 or the latest revision thereof must govern the design, component materials, construction, and manufacture and testing of all resilient-seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The Engineer reserves the right to limit the purchase of resilient seat gate valves from manufacturers and to the models specified, as shown in Table 13, provided such resilient seat gate valves conform to the provision.

Table 13
Resilient Seat Gate Valves

Manufacturer	Model
Sizes 3"–12"	
American Flow Control	Series 500
Clow Valve Company	2640
Kennedy Valve	Ken-Seal II
M&H Valve Company	4067
Muller Company	2360 Series Gate Valve
United States Pipe & Foundry Company	Metroseal 250
Sizes 16"–24"	
United States Pipe & Foundry Company	Metroseal 250

The minimum design working water pressure for gate valves with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., and 12 in. must be 200 pounds per square inch gauge (psig) unless otherwise specified.

The minimum design working water pressure for gate valves with nominal diameters of 16 in. and 20 in. must be 150 psig unless otherwise specified.

Valves must be resilient-seated types, bronze mounted with non-rising stems (NRSs). The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open, the valve must have a clear, full-port, unobstructed waterway.

Gray iron (GI), DI, steel, brass, and bronze materials must meet or exceed the material requirements of "Section 2: Materials" of AWWA C-509-01.

Gaskets, O-rings, coatings, and elastomers must meet or exceed the material requirements of "Section 2: Materials" of AWWA C-509-01.

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves must be designed for buried installation with stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM-recognized alloy specifications of low-zinc content bronze, as shown in Table 1 of Section 2.2.4. of ANSI/AWWA C-509-01, or the latest revision thereof. Materials for the stem must:

- have minimum yield strength of 40,000 psi;
- have minimum elongation in 2 in. of 12%;
- be made of bronze per ASTM B763, Alloy No. Unified Numbering System (UNS) C99500; and
- have maximum zinc content of 2% as shown in Table 2, "Chemical Requirements," of ASTM B763-96 or the latest revision thereof.

Stem nut material must be ASTM B62, UNS C83600, or ASTM B584, UNS C84400. The stem must have a visible external marking at the top to indicate low-zinc, high-strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, MJ, push-on joint, or any combination thereof, as specified. All MJ valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements of ASTM A307 with dimensions in accordance with ANSI B 18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of either GI or DI.

- Bonnet
- Body
- Yoke
- Wrench nut
- O-ring packing plate or seal plate
- Gland follower

The gate may be made of GI or DI.

If glands and bushings are used for NRS valves, they must be made of ASTM B763, bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B763, bronze UNS C99500. The stem nut material must be ASTM B62, bronze UNS C83600, or ASTM B584, bronze UNS C84400. The gate may be made of ASTM B763, bronze UNS C99500. Stem seals must be O-ring type. The seals must be designed for dynamic applications.

The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position.

Materials for the O-ring packing plate must be in accordance with Section 4.8.3 of ANSI/AWWA C-509-01, or the latest revision.

Enclosed and buried valves must be coated inside and outside with a fusion-bonded epoxy with nominal 8-mil dry film thickness that meets or exceeds AWWA C-550-01, and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service per ANSI/NSF 61.

The Contractor must submit three sets of certified drawings showing the principal dimensions, general construction, and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this Specification must be approved by the utility owner. The manufacturer must provide an affidavit of compliance in accordance with Section 1.5 of ANSI/AWWA C-509-01 or latest revision thereof, to include compliance with the utility owner. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of ANSI/AWWA C-509-01 or latest revision thereof must be made available or provided. These records must be representative test results for Section 6.1 and certificate of testing for Section 6.2. An affidavit of testing for the valve assembly as outlined in Section 6.2.2 of ANSI/AWWA C-509-01 (350 ft.-lb.) must also be provided. A copy of the manufacturer's QA program must be submitted. Blueprints and parts list for the valve must also be provided.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged.

- An internal test pressure of twice the rated design working pressure of the valve
- The full-rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full-rated unbalanced working water pressure

In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows.

- 200 ft.-lb. for a 3-in. nominal diameter
- 200 ft.-lb. for a 4-in. nominal diameter
- 300 ft.-lb. for a 6-in. nominal diameter
- 300 ft.-lb. for an 8-in. nominal diameter

- 300 ft.-lb. for a 10-in. nominal diameter
- 300 ft.-lb. for a 12-in. nominal diameter

For sizes larger than a 12-in. nominal diameter, refer to the manufacturer's specifications.

Resilient seats must be applied to the gate and must seat against a corrosion-resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in accordance with ANSI/AWWA C-550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D429, either Method A or Method B, must prove the method used for bonding or vulcanizing. For Method A, the minimum strength must not be less than 250 psi. For Method B, the peel strength must be 75 lb. per inch.

The end flanges of flanged valves must be in accordance with dimensions and drillings of ANSI/AWWA C-110/A 21.10 or ANSI B-16.1, Class 125.

MJ bell dimensions must be in accordance with ANSI/AWWA C-111/A 21.11.

Push-on joints must be in accordance with the requirements of ANSI/AWWA C-111/A 21.11.

The tapping valves must be MJs with tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear, unobstructed waterway.

The seat rings must be of a large diameter to the permit entry of the full-diameter tapping machine cutters. The valve end that mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip must be dimensioned in accordance with Manufacturers Standardization Society (MSS) SP-60 for valves 20-in. nominal pipe size and smaller.

All interchangeable parts must conform to their required dimensions and must be free of defects that could prevent proper functioning of the valve. When assembled, valves manufactured in conformance with this standard must be well fitted and operate smoothly. All like parts of valves of the same model and size produced by the same manufacturer must be interchangeable.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

All gate valves must be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and zero pressure applied to the other side. The test must be made in each direction across the gate. All tests must be performed at the manufacturer's plant.

All gate valves must be operated through a complete cycle in the position for which they were designed to ensure free and proper functioning of all parts in the intended manner. Any defects in workmanship must be corrected and the test repeated until satisfactory performance is demonstrated. All tests must be performed at the manufacturer's plant.

A hydrostatic test pressure equal to twice the rated working pressure of the valve must be applied to all assembled valves with the gates in the open position. The test must show no leakage through the metal, pressure-containing joints, or stem seals. All tests must be performed at the manufacturer's plant.

A test must be made from each direction at rated working pressure to prove the sealing ability of each valve from both directions of flow. The test must show no leakage through the metal, through the pressure-containing joints, or past the seat. All tests must be performed at the manufacturer's plant.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, and the designation of working water pressure (e.g., 200 W).

The Engineer may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards is grounds for rejecting the entire order.

Table 13 identifies specified manufacturers that are approved.

2.6.1.2. **Workmanship**. All parts of the resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C-509-01, or latest revision thereof, and this Specification.

All parts of the resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free of defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must be in accordance with the testing requirements of this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The resilient seat gate valves must be well fitted.

Operation of the resilient seat gate valve must be smooth.

All parts must be free of structural defects.

The resilient seat gate valve must be watertight.

2.6.1.3. **Painting**. All exterior and interior surfaces of the valve must be coated with epoxy, NSF-61 certified. The epoxy must have a nominal dry film thickness of 8 mils and must be in accordance with AWWA C-550, latest revision.

Coating must be as close to holiday-free as is technologically possible.

2.6.1.4. **Testing**.

2.6.1.4.1. **Hydrostatic Test**. Hydrostatic test must be performed on the valve in accordance with Section 6.1., "Proof of Design Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.2. **Torque Test**. Torque test for prototype valves must be performed on the valve in accordance with Section 6.1., "Proof of Design Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.3. **Leakage Test**. Leakage test must be performed on the valve in accordance with Section 6.1., "Proof of Design Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.4. **Pressure Test**. Pressure test must be performed on the valve in accordance with Section 6.1., "Proof of Design Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.5. **Operation Test**. Operation test must be performed on the valve in accordance with Section 6.2., "Production Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.6. **Shell Test**. Shell test must be performed on the valve in accordance with Section 6.2., "Production Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.7. **Seat Test**. Seat test must be performed on the valve in accordance with Section 6.2., "Production Testing," of ANSI/AWWA C-509-01 or latest revision.

2.6.1.4.8. **Compliance**. An affidavit of compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3., "Affidavit of Compliance," of ANSI/AWWA C-509-01.

The affidavit of compliance, the results of ASTM testing procedures and requirements for materials, the manufacturer's QA program, and the records of all tests performed on the valve must be kept and provided by the supplier or manufacturer in a single hard-cover bound notebook with the bid or with the shipping documents and must be approved.

2.6.1.5. **QA**. Manufacturers must have an ASME or ISO-9001 registered commercial quality system or be in the process of achieving this certification by June 2025. Noncompliance with this registered commercial quality system requirement by June 2025 will result in removal of the manufacturer's product from the approved manufacturers list. If, on receipt of resilient seat gate valves, they are found to be noncompliant, the manufacturer must replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets ANSI/AWWA C-509 specifications, latest revision. The defective resilient seat gate valve must be returned to the manufacturer, freight-collect, and the manufacturer must replace the resilient seat gate valve, freight-prepaid.

2.6.1.6. **References**.

- ANSI/AWWA C-509-01
- MSS SP-60

2.6.2. **Tapping Valves and Tapping Sleeves**.

2.6.2.1. **Tapping Sleeves**. Band must be in accordance with the minimum OD size ranges and lengths specified in this Specification. The flange must be manufactured in accordance with AWWA C-207, Class D, ANSI B.16.1 drilling, recessed for tapping valves MSS SP-60. MJ tapping sleeve outlet must meet or exceed all material Specifications as listed below and be suitable for use with standard mechanical joint × mechanical joint resilient wedge gate valves per AWWA C-509-94.

2.6.2.1.1. **Tapping Sleeves, 4 in.–12 in**. Entire fitting must be stainless steel Type 304 (18-8). The body, lug, and gasket armor plate must be in accordance with ASTM A240. The flange must be cast stainless steel in accordance with ASTM A743. The MJ outlet must be one-piece casting made of stainless steel. The test plug must be 3/4-in. NPT in accordance with ANSI B 2.1 and must be lubricated or coated to prevent galling. All metal surfaces must be passivated after fabrication in accordance with ASTM A380.

The gasket must provide a 360° continuous sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to effect a positive seal under combinations of joint and gasket tolerances. The materials used must be vulcanized natural or synthetic rubber with antioxidants and antioxidant ingredients to resist set after installation. No reclaimed rubber may be used. A heavy-gauge Type 304 stainless armor plate must be vulcanized into the gasket to span the lug area.

Lugs must be heliarc welded (gas metal arc welding) to the shell. Lug must have a pass-through bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts must not be integrally welded to the sleeve. Finger lug designs are not approved; it is the intent of these Specifications to allow tapping sleeve that has a lug design similar to the approved models.

Bolts and nuts must be Type 304 (18-8) stainless steel and lubricated or Teflon coated to prevent galling or seizing. Bent or damaged unit must be rejected.

QC procedures must be employed to ensure that the shell, lug (4-in. and larger nominal pipe diameter), armor plate, gasket, and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working PR up to 200 psi and a test pressure of 250 psi.

The sleeve construction must provide a positive means of preventing gasket cold flow and extrusion.

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent-type, water-resistant, that do not smear or become illegible.

2.6.2.1.2. **Tapping Sleeves 16 in. and Larger Nominal Pipe Diameter**. The body must be in accordance with ASTM A285, Grade C, or ASTM A36. Test plug must be 3/4-in. National Pipe Taper Thread (NPT) in accordance with ANSI B 2.1.

The gasket must provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket must ensure a positive seal under all combinations of joint and gasket tolerances. Gasket must be formed from vulcanized natural or synthetic rubber with antioxidant ingredients to resist set after installation. No reclaimed rubber may be used. Bolts and nuts must be type high-strength, corrosion-resistant, low-alloy per AWWA C-111, ANSI A 21.11.

QC procedures must be employed to ensure that the shell, gasket, and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working PR up to 150 psi, and a test pressure of 200 psi.

Unless otherwise noted, unit must be protected by fusion Epoxy 8-10 mil line and coat per AWWA C-213.

Units for concrete steel cylinder (CSC) pipe must be furnished with load-bearing set screws on the gland flange to transfer loads on the outlet away from the steel cylinder and onto the sleeve. Epoxy-coated tapping sleeves do not require grout seal cavity (AWWA *Manual of Practice* M-9).

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent-type, water-resistant, that do not smear or become illegible.

2.6.2.1.3. **Tapping Sleeve Standard Ranges**. Standard ranges of tapping sleeves are listed in Table 14.

Table 14
Tapping Sleeve Standard Ranges

Nominal Diameter × Min Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
4 × 16	4	A	4.75–4.95
		B	4.90–5.10
6 × 16	4	A	6.70–7.10
		B	7.00–7.40
		C	7.35–7.75
6 × 16	6	A	6.80–7.15
		B	7.05–7.40
		C	7.40–7.75
8 × 16	4 and 6	A	9.00–9.45
		B	9.35–9.70
		C	9.70–10.00
8 × 20	8	A	9.00–9.35
		B	9.35–9.70
		C	9.70–10.00
10 × 16	4 and 6	A	11.03–11.47
10 × 20	8	B	11.60–12.00
10 × 24	10[2]	–	–
12 × 16	4 and 6	A	13.00–13.40

Nominal Diameter × Min Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[1]
12 × 20	8	B	13.40–13.80
12 × 24	10	C	14.40–14.50
12 × 32	12[2]	–	–
16 × 12	4 and 6	–	17.33–17.87
16 × 16	8	–	18.62–19.19
16 × 20	10[2]	–	–
16 × 24	12[2]	–	–
16 × 36	16[2]	–	–
20 × 12	4 and 6	A	21.51–22.15
20 × 16	8	B	23.46–24.16
20 × 20	10[2]	–	–
20 × 24	12[2]	–	–
20 × 36	16[2]	–	–
20 × 40	20[2]	–	–
24 × 12	4 and 6	A	25.71–26.41
24 × 16	8	B	28.14–28.84
24 × 20	10[2]	–	–
24 × 24	12[2]	–	–
24 × 36	16[2]	–	–
24 × 40	20[2]	–	–
24 × 48	24[2]	–	–
30 × 12	4 and 6	A	29.78–30.48
30 × 16	8	B	31.52–32.22
30 × 20	10[2]	–	–
30 × 24	12[2]	–	–
30 × 36	16[2]	–	–
30 × 40	20[2]	–	–
30 × 48	24 × 30[2]	–	–

1. Ranges may be broadened but not narrowed. For CSC pipe, the OD of the pipe and cylinder must be supplied with the order.
2. Range to be specified when ordered.

For pipe larger than 30 in. nominal diameter, tapping sleeves must be custom fabricated to fit nonstandard ranges, in accordance with the intent of these Specifications.

The Engineer may, at no cost to the Contractor, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards is grounds for rejecting the entire order.

Table 15 lists identified specific manufactured items by catalog number that are approved.

Table 15
Approved Tapping Sleeves and Manufacturers

Manufacturer	Model	Size Range (in.)
JCM Industries	#432	4–12
	#412	16 and larger
Power Seal	#3490AS or #3490MJSS	4–12
	#3490MJSS	16 and larger
Romac Industries	SST III	4–12
	SST III	16 and larger
Ford Meter Box	FTSS	4–12
	FTS	16 and larger

Manufacturer	Model	Size Range (in.)
Dresser	Style 610/630	4–12
	Style 610/630	16 and larger
Cascade	CST-1	4–12
Smith Blair	#622	16 and larger
Total Pipe Solution	Triple Tap TS	4–12

2.7. **Valve Boxes**. All valve box assemblies must conform to the details shown on the plans. Each valve box assembly must be of CI and must consist of a base, top section, and lid.

Valve boxes must be of a single size with a nominal diameter of 6 in.

The valve box lid must be labeled "Water" and must be designed so that it remains firmly seated in place when subjected to vehicular traffic.

The valve box assembly must be tough and strong enough to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly must be coated with a standard bituminous coating of either coal tar or asphalt base applied to all inside and outside surfaces.

2.8. **Meter Boxes**. For non-traffic bearing locations, the meter box assembly for 5/8-in.–1-in. meter box and lid must be black and constructed of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection and must be uniform throughout meter box and lid for maximum longevity and not have a foaming agent that creates air pockets within the plastic wall. The body and lid must withstand a 20,500-lb. loading in non-deliberate and incidental traffic.

Plastic lid must have the following.

- "Water Meter" and utility owner molded into the lid
- Secure and even seating inside the meter box without overlapping the top edge of the meter box
- Secure and even overlap on the existing utility owner CI meter box with like dimensions
- A diamond pattern for skid resistance and an automated meter reading (AMR) slide mount molded into the lid on the underneath side and off center for placement of an AMR transponder to help in the protection of the radio antenna
- A brass worm gear lock that secures the existing utility owner CI meter box of like dimensions and secures the plastic meter box
- A molded receptacle for placement of utility owner key
- One piece of 1/2-in. rebar secured in lid

Plastic body must have the following.

- A crush-resistant ribbing along the outside of box
- A flange around the top opening to help prevent setting and aid in adjustment to grade
- Design to accommodate all plastic lids

For traffic-bearing locations, the meter box assembly for 5/8-in.–2-in. meters must consist of CI rectangular boxes and a steel checkered plate rectangular with raised lug pattern as shown on the plans.

The castings must be dipped in coal tar at a temperature of 350°F, and the metal must be at a temperature of 300°F before dipping. The casting must be dipped and cured independently, and the coating must have ceased to be tacky within 72 hr. after dipping.

The steel checkered plate rectangular cover must be hot-dip galvanized after fabrication.

The meter box must have an ultimate tensile strength of 25,000 psi and not be brittle.

The casting must have an “as cast” clean, smooth surface and be free of internal porosity; castings that are made smooth by grinding are unacceptable.

2.8.1. **QA**. If, on receipt of meter boxes or lids, they are found to be noncompliant, the Contractor must replace defective product at no cost to the Department. Any visible defect or failure to meet Specification is grounds for rejecting entire order.

2.8.2. **Approved Plastic Meter Box and Lid Manufacturer**. DFW Plastics, Inc.

Model numbers:

- **D-1218-RWSBSM**. Complete box.
- **D-1218-RWSBSM**. Lid.
- **D-1218**. Body.

2.9. **Fire Hydrants**.

2.9.1. **General**. The Engineer reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified, as shown in Table 16, provided such fire hydrants conform to the provision contained.

Table 16
Approved Fire Hydrant Maintenance Kits

Manufacturer	Model
American Darling	B84B 5-1/4" (with metal weather cap)
Clow Valve Company	Medallion
Kennedy Valve Company	Guardian
M&H Valve Company	Reliant Model 929
Mueller Company	Super Centurion 250
United States Pipe and Foundry, Inc.	Metropolitan
Waterous	Pacer 100
American AVK Company	Model 2780 Dry

Each hydrant must be designed for a minimum working pressure of 200 psig.

All parts of the hydrant must be designed to withstand, without being functionally impaired or structurally damaged, a hydrostatic test of no less than 400 psig or twice the rated working pressure, whichever is greater, with the hydrant completely assembled and pressurized as follows.

- With the nozzle caps in place, the main valve open, the hydrant inlet capped, and the test pressure applied to the interior of the hydrant.
- With the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet.
- The design safety factor of the operating mechanism no less than 5 and based on the foot-pounds of torque required for the closing and opening of the hydrant at a working pressure of 200 psig. Hydrants must be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200 ft.-lb. at the operating nut in the opening direction with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5-ft. bury or less.

The length of bury must be as specified.

The fire hydrant must have two hose nozzles and one pumper nozzle.

The nominal ID of the hose nozzle must be 2-1/2 in.

The nominal ID for the pumper nozzle must be 4 in.

The outlet-nozzle threads must be in accordance with NFPA 2003, *Standard for Fire Hose Connections*.

The nominal diameter of the main valve opening must be 5-1/4 in.

The hydrant shoe must be provided with a 6-in. MJ connection to fit the connecting pipe.

The fire hydrant must open right (clockwise).

The color of the finish paint above the ground line must be aluminum; however, fire hydrants for private use must be painted red.

The fire hydrant must have an NRS.

No more than one 6-in. stem extension may be provided if required to make the base of the fire hydrant grade level.

The bonnet section must be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir must be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir must be sealed. The reservoir must be adequately sealed with O-rings or other suitable sealing system approved.

The fire hydrant must have a safety flange or breakaway flange at the ground line as stipulated in Section 3.1, “General Design,” of ANSI/AWWA C-502-05 or latest revision.

Fire hydrant nozzle cap chains are required and must be attached permanently to the fire hydrant as stipulated in Section 3.2, “Detailed Design,” of ANSI/AWWA C-502-05 or latest revision.

Parts that require lubrication and come into contact with water must be lubricated with a nontoxic food-grade lubricant that does not pose a health hazard to the public if consumed.

2.9.2. **Workmanship**. All foundry and machine work must be performed in conformance with good standard practice for the class of work involved and in conformance with accepted drawings, if required. When assembled, hydrants manufactured in accordance with this Specification must be well fitted and must operate smoothly. The body and shaft must be watertight.

All parts must conform to the required dimensions and must be free of defects that could prevent proper functioning of the hydrant.

All castings must be clean and sound, without defects that will weaken their structure or impair their service.

2.9.3. **Paint**. The exterior surface of the hydrant must be coated with a coating that meets or exceeds the requirements of Federal Specification TT-C-494b. A second coat of water-based or oil-based enamel paint, aluminum in color, must then be applied from the top of the hydrant to a point 18 in.–20 in. below the centerline of the pumper nozzle, or down to the traffic safety flange connection at the ground line.

All interior surfaces and machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, must be coated with a coating that meets or exceeds Federal Specification TT-C-494b. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

The interior and exterior of the hydrant shoe must be coated with a fusion-bonded epoxy with a nominal dry film thickness of 8 mils, in accordance with ANSI/AWWA C-550-05, and certified to NSF 61.

Coating must be as close to holiday-free as technologically possible.

2.9.4. **Testing and Inspection**. Each assembled hydrant must be subjected to two shop tests under a hydrostatic pressure of 400 psig, or twice the rated working pressure, whichever is greater. One test must be made with the entire interior of the hydrant under pressure, and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there must be no leakage through the main valve or seals, the castings, or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valves must not exceed 5 fluid ounces per minute. Other leakage or other imperfections found in either test must be corrected or the hydrant retested. The tests must be conducted for enough time to allow a check of all points of possible leakage and for a minimum of 30 sec. after all air has been exhausted.

Each assembled hydrant must be operated through a full open-close cycle when not under pressure. The torque required for performing this operation must not exceed 200 ft.-lb.

All fire hydrant tests and inspections must be in accordance with ANSI/AWWA C-502, Section 5.1, "Production Testing"; ANSI/AWWA C-502, Section 5.2, "Prototype Testing"; and ANSI/AWWA C-502-05, Section 5.3, "Inspection and Rejection."

The manufacturer must provide an affidavit of compliance in accordance with Section 1.7, "Affidavit of Compliance," of ANSI/AWWA C-502-05, or latest revision thereof.

2.9.5. **QA**. Manufacturers must have an ASME or ISO-9001 registered commercial quality system or be in the process of achieving this certification by June 2005. If, on receipt of fire hydrants, they are found to be noncompliant, the Contractor must replace the defective fire hydrants according to fire hydrant size with a fire hydrant that meets this Specification.

The utility owner must attempt to use fire hydrant maintenance kits in the approved hydrants. Table 16 provides the product model numbers. The fire hydrant maintenance kits listed are the reference product model numbers.

2.9.6. **References**.

- ANSI/AWWA C-502-05
- ANSI/AWWA C-550-05

2.10. **Polyethylene Wrapping Material**. Polyethylene wrapping material must be used to encapsulate all DIP and CIP.

Polyethylene wrapping for DI and CI water mains must consist of a 4-mil tubular section of cross-laminated high-density polyethylene (HDPE), which has a high dielectric and tensile strength, for use in insulating CIP and DIP from the electrolytic action encountered in highly active soils.

Polyethylene wrapping must consist of opaque cross-laminated HDPE sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 17 for size and length chart, in accordance with AWWA C-105, Table 1, for minimum requirements. When supplied in specific pipe lengths, the tubes must contain a minimum of 4 ft. more than the actual pipe length to allow for overlap. Table 18 contains the approved polyethylene wrapping manufacturers and products.

Table 17
Four-mil Polyethylene Wrapping Materials Size and Length (All Sizes Lie Flat)

Pipe Size (in.)	Product Size (Width × Length) (in.)
4, 6, and 8	20 × 200/500
8, 10, and 12	27 × 200/500
16 and 18	37 × 200/500

Pipe Size (in.)	Product Size (Width × Length) (in.)
20	41 × 200/500
24	54 × 200/500
30	67 × 140/500
36	81 × 120/500
48	95 × 100/500
54	108 × 100/500

Table 18
Approved Polyethylene Wrapping Manufacturers and Products

Manufacturer	Product
Van Leer Flexibles, Inc.	Valeron
Manufactured Plastics and Distribution, Inc.	Cross Tuff 450 Black

The polyvinyl sheet of film for the tubular wrapping must be of virgin resins meeting raw and physical properties of ASTM D1248 and AWWA C-105, latest edition. The material must be 4-mil cross-laminated HDPE of uniform film thickness and be free of imperfections such as pin holes, after being thermally seamed into tubular form. The finished product must have a nominal thickness of 4 mils, with tolerances of -10%.

The material must have no volatile constituents, the loss of which may affect ductility. The material must also have the following properties.

- **Mechanical**. The polyethylene film must have a tensile strength per latest ASTM D882 test, of 6,300 psi minimum. The film must have an elongation of no less than 100% of the test strip per latest ASTM D882 test. The film must have an impact resistance of 800 g minimum per ASTM D1709, Method B. The film must have a propagation tear resistance of 250 grams force minimum in machine and transverse direction (ASTM D1922).
- **Dielectric**. The film must have a dielectric strength of 800 V per mil thickness per ASTM D149.

2.10.1. **Marking Requirements**.

The polyethylene film supplied must be clearly marked, at a minimum of every 2 ft. along its length, containing the following information.

- Manufacturer's name or trademark
- Year of manufacture
- ANSI/AWWA C-105/A 21.5
- Minimum film thickness and material type
- Applicable range of nominal pipe diameter sizes
- The phrase "Warning-corrosion protection-repair any damage"

The Engineer may, at no cost to the Contractor, subject random testing by an independent laboratory in accordance with this Specification. Any visible defect or failure to meet the quality standards is grounds for rejecting the entire order.

2.11. **Mechanical Couplings**. Mechanical coupling of dresser or similar type must be used to connect plain ends of CSC pipe and plain ends of steel and DI pipe, and to connect new and existing DI water main in conjunction with casing installation in accordance with the details shown on the plans.

The mechanical coupling must consist of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring must be flared at each end to receive the wedge-shaped gasket, which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

The flexible and transition couplings must be manufactured to fit the type, size, and class of pipe specified. Bolts must be high-strength, low-alloy steel meeting the requirements of AWWA C-111.

2.12. **Air Release Assemblies**. Valve body and cover must be CI fabricated in accordance with ASTM A48-35 or ASTM A126, Class B. Non-metallic valve body must be fabricated from fiberglass-reinforced nylon. Inlet sizes through 2 in. must be screwed (NPT). Pipe sizes 3 in. and more must have flanged inlets (125 lb. ANSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Internal seat trim float arm and pivot pin must be stainless steel Type 303, 304, or 316. Floats must be stainless steel ASTM A240. Other internal parts must be stainless steel ASTM A240 or ASTM A276.

Non-metallic floats must be foamed-polyethylene with stainless steel Type 316 fasteners.

Internal seat or orifice button must be of Buna-N rubber compounded for water service. Cover gasket must be composition-type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2 in. and less.

Valve body must have a test PR of 300 psi and working PR of 150 psi.

The air release valve must be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be either simple lever, compound lever, ball and orifice, or rolling seal depending on volume requirements and the design of the valve.

The air and vacuum valve must be designed with the inlet and outlet of equal cross-sectional area. The valve must be capable of automatically allowing large quantities of air to be exhausted during the filling cycle and capable of automatically allowing air to re-enter the system to prevent a negative pressure during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves must provide for automatic air release under system pressure and allow air movement during filling or draining operations or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sizes (4 in. and larger) may be furnished in a dual housing. When dual castings are used, a bronze manual isolation valve must be installed if indicated by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

The Engineer may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standard are grounds for rejecting the entire order.

The qualified product lists in Table 19, 20, and 21 identify specific manufactured items by catalog number that are approved.

Table 19
Air Release Valves (Inlet × Orifice)

Manufacturer	**1" NPT × 3/16"**	**2" NPT × 3/16"**
Apco Valve Company	200A	200A
G.A. Industries, Inc. (Empire)	920	920
Multiplex Mfg. Co. (Crispin)	P1-10	PL-10A
Val-Matic Mfg. Co.	38	38
PowerSeal Corporation	5401-D	5401-E
ARI Flow Control	S-050 1T	D-040 2T

Table 20
Air and Vacuum Valves (Inlet × Orifice)

Manufacturer	2" NPT × 3/16"	4" Flange with Cowl
Apco Valve Company	144	152
G.A. Industries, Inc. (Empire)	930	930-C
Multiplex Mfg. Co. (Crispin)	AL20	AL41
Val-Matic Mfg. Co.	102	104
PowerSeal Corporation	5402-B	5402-D
ARI Flow Control	D-040 2T	K060 C-HF

Table 21
Combination Air Valves (Inlet × Orifice)

Manufacturer	1" NPT × 5/64"	2" NPT × 3/32"	4" Flange × 3/32" with Cowl
Apco Valve Company	143C	145C	149C
G.A. Industries, Inc. (Empire)	945 (1" NPT)	945	960C
Multiplex Mfg. Co. (Crispin)	U10	UL20 (1/4")	UL41 (1/4")
Val-Matic Mfg. Co.	201C	202C	204C
PowerSeal Corporation	5403-A	5403-B	5403-D
ARI Flow Control	D-040 2T	D-040 D-060 C-HF	D-060 C-HF

2.13. **Blow-Off Assemblies and Jumper Connections**. The materials required for permanent and temporary 2-in. and 4-in. blow-off assemblies and 4-in. jumper connections are shown on the plans.

2.14. **Backfill**.

2.14.1. **Copper 3/4 in.–2 in**. Where services with 3/4-in.–2-in. copper are installed, initial backfill must be sand conforming to the following requirements.

- Natural or produced from crushed gravel or crushed rock maximum 1/4 in.
- Ninety-five percent must pass No. 4 sieve
- Free of clay and organic material
- Maximum 8% passing the No. 200 sieve

Larger services using DIP or PVC (C-900) pipe must be backfilled the same as mains.

2.14.2. **Bedding and Initial Backfill for Water Mains**. Well-graded gravels or crushed stone meeting the following requirements for Modified Grade 5 gravel.

- **Retained on 1/2-in. Sieve**. 0%.
- **Retained on 3/8-in. Sieve**. 0%–5%.
- **Retained on No. 4 Sieve**. 20%–80%.
- **Retained on No. 10 Sieve**. 75%–100%.
- **Retained on No. 20 Sieve**. 98%–100%.

The quantity and thickness of lifts and compaction of initial backfill materials must be in accordance with Section 7033.3.4.1., “Initial Backfill.”

2.14.3. **Secondary Backfill for Water Mains**. Approved materials excavated from the trench free of brush, debris, large rock or stones, and earth clods 6 in. or larger. Secondary backfill material must be primarily composed of compactable soil materials.

2.15. **Asphalt**. All asphaltic concrete used in the replacement of pavement over the trench line must be in accordance with Item 341, “Dense-Graded Hot-Mix Asphalt,” Type C, except when the use of 6 in. of asphalt-treated base is directed, unless otherwise specified on the plans.

2.16. **Concrete**. All concrete used as the trench cap and in sidewalks and blocking mains must be in accordance with Item 421, "Hydraulic Cement Concrete." Class A concrete must be used in sidewalks and for blocking CSC mains; Class D concrete must be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

2.17. **Reinforcing Steel**. All bar reinforcement must be Grade 40 or Grade 60, in accordance with the requirements of Item 440, "Reinforcement for Concrete."

2.18. **Affidavit of Compliance**. Unless otherwise directed, the Contractor must furnish a manufacturer's affidavit of compliance for each of the materials used in this project. The affidavit must certify that factory inspection and all specified tests have been made and that the material furnished complies with the requirements.

3. CONSTRUCTION

3.1. **Excavation**. Excavation (trenching) as required to complete the water main installation must be performed in accordance with Item 400, "Excavation and Backfill for Structures," as shown on the plans and as directed.

3.1.1. **Trenches**. Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top is not be permitted except where it is justified for safety or at the Engineer's or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed on the bedding material. Bell holes and depressions for joints must be dug after the trench bottom has been graded and bedding installed. The pipe must rest on the new bedding material for its full length.

Where over-excavation occurs, the undercut trench must be restored to grade at no cost to the Department by replacement with a material conforming to the requirements of the bedding material or a material as approved.

The depth of cut indicated on cut sheets, as furnished, is from the offset or cut hub elevation to the invert.

3.1.2. **Width of Trench**.

3.1.2.1. **Minimum Width of Trench**. The minimum width of pipe trenches, measured at the crown of the pipe, must be no less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be no less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and no greater than the width at the top of the trench.

3.1.2.2. **Maximum Width of Trench**. The maximum allowable width of trench for pipelines measured at the top of the pipe must be the OD of the pipe (exclusive of bells or collars) plus 24 in. A trench wider than the OD plus 24 in. may be used without special bedding if the Contractor, at their expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, in the Specifications, or by the written approval, the Contractor, at their expense, must encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved. Any excavation wider than this maximum width or subsequent surface or paving work must be completed at the Contractor's expense.

3.1.3. **Classification of Excavated Materials**. No classification of excavated materials will be made. Excavation and trench work must include the removal and subsequent handling of all materials excavated in accordance with Item 400.

3.1.4. **Grade of Trench Bottom**. The trench must be over-excavated to a depth of 6 in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe must then be met by the addition of a layer of approved bedding material as directed.

3.1.5. **Excavation Below Grade**. Any part of the bottom of the trench excavated below the limits specified in Section 7033.3.1.4., "Grade of Trench Bottom," must be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade must be restored in accordance with the methods described in Section 7033.3.1.6., "Unstable Conditions at Grade," at no cost to the Department.

3.1.6. **Unstable Conditions at Grade**. Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials that in the judgment of the Engineer should be removed, the Contractor must excavate and remove such unsuitable material to a depth at least 6 in. below pipe. Before the pipe is laid, the grade must be restored by backfilling with an approved material in layers of 3 in. before compaction. The layers must be slightly moistened and thoroughly compacted to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade must be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.

3.1.7. **Trench Excavation Protection**. All trench excavation required on this project must be accomplished as required by the provisions of Item 402, "Trench Excavation Protection."

3.1.8. **Caution in Excavation**. The Contractor must proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12 in. on either side of other existing underground utilities. The Contractor is responsible for the repair of such structures and utilities when broken or damaged. They are also responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the water main construction.

Whenever the Engineer determines that it is necessary to explore and excavate to determine the location of existing underground structures and utilities, the Contractor must make explorations and excavations for such purposes at their expense.

3.1.9. **Protection and Restoration of Underground Structures and Facilities**. The Contractor must furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work. All underground structures and utilities that are disturbed must be restored by the Contractor at their expense. Materials and methods used for restoration must be in conformance with the utility owner and the requirements of the utility agency involved.

If a sanitary sewer is broken by the Contractor's operations, the release of sewage into the trench must be immediately intercepted by the insertion of a section of sheet metal tubing known as a "tin-horn" between the broken ends of the sewer. All leakage at the ends of the tin-horn must be effectively stopped. The tin-horn must remain in place until permanent repairs can be made. It is the responsibility of the Contractor to determine enough in advance of their trenching operations the size of all sanitary sewer lines and services that will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, must have proper support consisting of sound timber supports with a minimum 2-in. nominal thickness and a minimum 6-in. nominal width placed with the width horizontal and extending a minimum of 12 in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material must be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to a distance of 6 in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged, must be properly marked, and care must be taken to avoid damage to the pipe by a hydratamping machine or other mechanical equipment. The Contractor is liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. **Backfill Material Derived from Excavation**. All excavated materials that the Engineer determines are suitable for reuse as trench backfill must be separated where practicable from the general excavation material, or as directed.

3.1.11. **Trench Restoration**. The surface of the backfilled trench must be restored to match the previous existing conditions. This must include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained lawns), or other unprepared and prepared surfaces. Trenches in alleys actively being used by vehicles (such as trash pickup and vehicle parking) must be restored by grading and compacting to 98% or higher with a minimum of 4 in. of flex-base materials for the entire width of the alley. Alleys not actively used by vehicles must be graded and compacted to 98% or higher, then spread with grass seed for entire width of the alley.

3.1.12. **Pavement**. The Contractor must remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration must be based on the minimum trench widths as specified, plus 6 in. either side or as otherwise provided. The Contractor must use such methods as sawing, drilling, or chipping to assure the breaking of the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces must be restored at the expense of the Contractor.

Where water line construction necessitates cutting through existing streets outside the limits of new street construction, said streets must be replaced in kind as directed.

Where in the opinion of the Engineer it is necessary to maintain traffic across a trench, the Contractor must install temporary metal bridges as necessary to facilitate the movement of traffic.

The street surface adjacent to the trench must be kept free of surplus spoil. Construction materials must be placed at locations that minimize interference with the traveling public.

3.1.13. **Concrete Sidewalks and Driveways**. All concrete sidewalks and driveways must be cut using a concrete saw. When transverse expansion or “dummy” joints are encountered, the concrete must be removed to the nearest transverse joint on each side of the trench and restored. The depth of cut must be such that upon removal of the concrete, the sides of the cut are straight and square.

Existing reinforcing wire fabric or bars must be cut and removed to permit completion of trench excavation, pipe laying, and backfill operations. When the backfill operations have been completed, the existing reinforcement must be replaced in its original position and satisfactorily spliced before the replacement of concrete over the new trench alignment.

Transverse “dummy” joints must be made by a jointing tool or other acceptable means and must match in depth and thickness in the existing transverse joints.

Expansion joint material must be provided where new construction abuts the existing curb or driveway if the Engineer deems it necessary.

Concrete must be spaded, tamped, and thoroughly compacted until mortar entirely covers the surface and has a monolithic finish. The top surface must be floated, troweled, and finished to match the existing concrete surface.

Immediately after finishing, the concrete surface must be protected by a membrane compound curing agent, wetted cotton, or burlap mats. Any method is subject to approval.

3.1.14. **Dewatering**. Prevent surface water and subsurface water or groundwater from flowing into excavations and from flooding project site and surrounding areas.

3.1.14.1. **Dewatering System**. The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

3.1.14.2. **Temporary Drainage Ditches**. Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil.

3.1.14.3. **Remedial Measures**. Should the pumping system draw fines from the soil, the Engineer must order immediate shutdown, and remedial measures are responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean condition that is acceptable to the Engineer.

The Contractor must maintain groundwater table at least 12 in. below the finished excavation subgrade.

3.1.14.4. **Dewatering Performances**. Performances of the dewatering system for lowering groundwater must be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the Engineer.

3.2. **Pipe Laying**.

General. The Contractor must start their work at a tie-in point, unless otherwise shown on the plans. Pipe must be laid with bell ends facing the direction of lying, unless otherwise authorized or directed. Under no circumstances may pipe be laid in water, and no pipe may be laid under unsuitable weather or trench conditions. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed. No valve or other control on the existing system may be operated for any purpose by the Contractor unless approved.

The Contractor must maintain a neat and orderly work area. Complete cleanup must be maintained at all times as closely behind the pipe-laying operations as possible, but in no case is such cleanup permitted to lag more than 1,000 ft. behind the pipe laying, unless otherwise directed.

The Contractor must maintain service to water connections, whether connected to the existing or proposed water lines, at all times for the duration of the construction, unless directed otherwise by the Engineer.

3.2.1. **Crossing Other Underground Lines**. New water mains crossing other utilities must have a minimum of 30 in. of cover over the top of the pipe unless otherwise waived or modified. Excavation around other utilities must be completed by hand for at least 12 in. all around. Any damage to the protective wrap on gas lines or electrodes must be reported immediately to CenterPoint Energy, (888) 876-5786. Any damage to other utilities must be reported to their proper governing entity.

3.2.2. **Pipe Grade**. Water mains 16 in. or smaller must have a minimum of 48 in. of cover from the proposed final finish ground or street elevation and 60 in. of cover when the main is installed in a parkway or under the pavement where there are no existing or proposed curb or existing drainage facilities. Water mains 20 in. and more must have a minimum of 60 in. of cover over the top of the pipe from the proposed final finish ground or street elevation unless otherwise waived or modified.

Pipe grades must be as required on the plans, or as directed. Grades must be met as specified by Section 7033.3.1., "Excavation." Care must be taken to ensure that the pipe barrel has uniform contact with the bedding material for its full length, except at couplings. The coupling must not be in contact with the original trench bottom before backfill. Bedding material must be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade may be made only at joints.

3.2.3. **Bedding and Bedding Materials**. Before placing pipe in a trench, the trench must have been excavated to the proper depth as required in Section 7033.3.1., "Excavation." Approved materials must be smoothly worked by hand across the entire width of the trench bottom to provide supporting bedding for the pipe.

Where the bottom of a trench at subgrade consists of material that is notably unstable as determined by the Engineer and cannot be removed and replaced with approved material, it may be properly compacted in place to support the pipe. The Contractor must also construct a foundation for the pipe consisting of piling, concrete beams, or other supports in conformance with plans prepared. Extra compensation will be allowed for the Contractor for the additional work completed. Coordinate with Engineer for approval of extra compensation before beginning work.

3.2.4. **Lowering Materials into Trench**. Proper implements, tools, and facilities satisfactory to the Engineer must be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench, piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and lining. Under no circumstances may water main materials be dropped or dumped into the trench. Take care to avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.5. **Installing Pipe**. Every precaution must be taken to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions or extended period of time, or otherwise required, a manufactured cap or plug must be used to prevent any foreign-type material entering. Leave the cap or plug in place until a connection is made to the adjacent pipe. Inspect the interior of each pipe for defects and reject if defects are found.

After placing a length of pipe in the trench, the jointed end must be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in compliance with the requirements specified. The pipe must be secured in place with approved backfill material tamped around it. Pipe and fittings that do not allow enough uniform space for joints must be rejected and replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress, the open end of pipe in the trench must be closed by a watertight plug or other approved means. Pipe in the trench that cannot temporarily be jointed must be capped or plugged at each end to make it watertight. This provision applies during all periods when pipe laying is not in progress.

Should water enter the trench, the seal must remain in place until the trench is completely dry. The Contractor must provide plug and caps of various sizes required.

3.2.5.1. **Steel Pipe**. The Contractor must furnish all steel piping, including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories that are shown on the plans, and as required for proper connection to

existing piping. The Contractor's attention is directed to the fact that the exact location and elevation of existing piping must be determined in the field before fabrication of connecting piping.

All steel pipe and specials may be either mill pipe or fabricated pipe and, in either case, must be fabricated to the sizes, dimensions, and shapes as shown on the plans. Unless otherwise shown on the plans, all steel pipe, bends, or specials must have an OD minimum wall thickness and unit weights as shown on plans.

3.2.5.1.1. **Ends of Sections**. Ends of pipe sections, bends, and specials must be beveled for field welding, unless otherwise shown on the plans.

3.2.5.1.2. **Seams**. All piping must be made from steel plate rolled into cylinders or sections thereof, with no more than two longitudinal butt welds, or must be spirally formed and butt welded. Girth seams must be butt welded and not be closer than 6 ft. apart, except in specials and bends.

3.2.5.1.3. **Length Tolerance**. Standard and special section must be within ±1/16 in. of the specified or theoretical lengths.

3.2.5.1.4. **Welded Joints**. Except where ends are shown on the plans to be joined by mechanical couplings, all joints for steel pipe installed on a bridge structure and in open trench must be welded.

Welders appointed to do welding on steel pipe must be certified with 4F and 5G certification. All welds must be sound, be free of embedded scale and slag, have a tensile strength across the weld at least that of the thinner of the connective sections, and be watertight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. Welds are subject to pre-manufacturing inspection and available to the Engineer by request.

Welding for field joints must be in accordance with the applicable requirements of AWWA C-206, "Standard Specification for Field Welding of Steel Water Pipe Joints." Parties involved in the construction of mains must pay special attention to AWWA C-206, "Control of Temperature Stresses." After welding, the joints must be prepared, primed, painted, or wrapped in accordance with this Specification.

Repair leaks in welds by chipping out defective material and re-welding. Hammering is not permitted.

3.2.5.2. **PVC (C-900 and C-905)**. Lay PVC mains to the depths and grades shown on plans. Lay pipe by inserting spigot end into bell flush with insertion line or as recommended by manufacturer. At no time is bell end allowed to go past "insertion line." A gap between end of spigot and adjoining pipe is necessary to allow for expansion and contraction.

3.2.6. **Defective or Damaged Material**. Pipe and accessories must be inspected for defects before being lowered into the trench. Any pipe section, fitting, or special that shows dents, kinks, abrupt changes of curvature other than specified, or any other damage must be rejected. Any pipe section, fittings, or special section that have been dropped from a truck or crane must be rejected. The Contractor must, at their expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material must be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor must furnish, at their expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its prior condition just before the failure of the pipe. Should the Contractor damage the pipe after installation, the Engineer may permit the damaged section to be cut from the length unless it is the opinion of the Engineer that the entire length was damaged. The cost and replacement of broken pipe is at the expense of the Contractor.

3.2.7. **Holes at Bells and Collars**. Bell holes of sufficient size must be provided at each joint to permit the joints to be made properly. For mechanical-type joints, the minimum clearance between the bell and natural ground must be 6 in. in all directions. Bell holes for CSC pipe must be of sufficient size to properly joint the pipe and

place the required grout. Subject to the above provisions, the length of excavation for bell holes below grade of the trench bottom must be kept to a minimum.

3.2.8. **Deviations in Line or Grade**. Wherever obstructions not shown on the plans are encountered during the progress of the work, and such obstructions interfere to such an extent that an alteration on the plan is required, the Engineer has the authority to change the plans and direct a deviation from the line and grade, or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstruction. Any deviation from the line must be accomplished by the use of appropriate bends unless such requirements are specifically waived by the construction Inspector.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed. In no case may the amounts shown in Table 22 and Table 23 be exceeded.

Table 22
Maximum Deflections of DIP

Normal Pipe Diameter (in.)	Max Deflection Angle (Degrees/Minutes)	Max Deflection in Inches with Pipe Length of:		Approximate Radius of Curve in Feet Produced by Succession of Joints with Pipe Length of:	
		18'	20'	18'	20'
6	4/25	16.7	18.5	234	260
8	3/51	14.6	16.2	268	297
10	3/42	14.0	15.5	279	310
12	3/08	11.9	13.2	327	363
16	2/21	8.8	9.7	440	488
20	1/55	7.2	8.0	540	600
24	1/35	6.0	6.7	648	720

Table 23
Maximum Deflections of CSC Pipe

Nominal Pipe Diameter (in.)	Max Deflection Angle (Degrees/Minutes)	Maximum Deflection (in.)		Approximate Radius of Curve (ft.)	
		16' Lay Length	20' Lay Length	16' Lay Length	20' Lay Length
16	2/20	–	9.8	–	500
20	1/52	–	7.8	–	600
24	1/34	–	6.6	–	750
30	1/16	–	5.3	–	900
36	1/02	–	4.3	–	1,100
42	0/54	–	3.8	–	1,300
48	0/47	2.6	–	1,170	–
54	0/44	2.5	–	1,237	–
60	0/54	3.0	–	1,024	–

3.2.9. **Cutting Pipe**. The cutting of pipe for inserting valves, fittings, or closure pieces must be accomplished to produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances may a worker not equipped with proper safety goggles, helmet, and other required safety attire be permitted to engage in this work.

No field cutting is allowed on asbestos-cement (AC) pipe. Repairs to AC pipe must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC pipe or DIP and fittings. All cuts made on DIP must be completed using a torch or power saw. The cuts must be made at right angles to the pipe axis and must be smooth. The edges of the cut must be finished smoothly using a hand or machine tool to remove all rough edges. The outside edge of pipe must be finished with a small taper at an angle of approximately 30°.

Field-cut PVC (C-900 and C-905) using a power saw with a steel blade or abrasive disc, depending on the size of pipe. If a bevel is needed after field cutting, it should be in conformance with Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings is allowed.

3.2.10. **Coating and Wrapping Underground Pipe**.

3.2.10.1. **Steel Pipe**. Steel pipe, bends, and specials must be prepared, primed, painted, or wrapped in the field as follows.

- **Exterior Surface Above Ground**. Exterior surfaces of new pipe and appurtenances installed must be thoroughly cleaned to bare metal by high-speed wire brushing, scraping, or other approved suitable methods, and given a single coat of industrial-grade rust-inhibitive primer and two finish coats of aluminum paint.
- **Exterior Surfaces Under Ground**. Exterior surface of steel pipe, bends, and specials installed in open trench must be thoroughly cleaned to bare metal by high-speed wire brushing, scraping, or other suitable approved methods; given a single coat of rust-inhibitive primer; and wrapped with polyvinyl tape in accordance with AWWA C-203-91, “Protective Coatings for Steel Water Pipelines,” Appendix C.
- **Flanged and Mechanical Coupling Joints**. The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe must be as specified.
- **Interior Surfaces**. The interior surfaces of steel pipe, fittings, and specials must be cleaned by sandblasting and then primed and coated in the shop with coal-tar enamel.

3.2.10.2. **DIP**.

3.2.10.2.1. **Open Trench**. DIP to be installed in a trench must be protected in the following manner.

- Each pipe joint must be covered with a 4-mil thick polyethylene sleeve that is 2 ft. longer than the pipe joint.
- The sleeve must cover the full length of the pipe joint, lap over 1 ft. on each end of the adjoining pipe joints, and be secured with a minimum of two circumferential turns of pressure-sensitive polyvinyl tape.
- Excess material must be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe, and held in place by means of pieces of pressure-sensitive tape at approximately 5-ft. intervals.
- After assembling the joint, the polywrap tube from the previously installed pipe must be pulled over the joint and secured by the Contractor.
- The polywrap tube from the new joint must be pulled over the first tube and secured to provide a double seal.

CI and DI fittings must be completely wrapped in 8-mil thick polyethylene films with a minimum of 1-ft. overlap on each end and appropriately taped. Laps must cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve must be wrapped as specified.

Any damaged areas in the polyethylene film must be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 ft. minimum in any direction and appropriately taped. Exercise care at water service locations to ensure that film and tape extend beyond corporation stop a minimum of 1 ft. onto the water service line.

Before placing pipe in the trench, a cushion of approved materials must be placed in the trench as required by Section 7033.3.4., “Backfill.” Backfill material must be carefully placed on the pipe to avoid any damage to the polyethylene sleeve.

Use care to protect and preserve polyethylene wrap around DI water mains when installing service corporations. The required method is to wrap pipe tape around pipe over polywrap in the area to be tapped. The tap must be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, the corporation, and the first 3 ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

3.2.10.2.2. **In Casing**. Where DIP is installed in a bore, the pipe must be thoroughly cleaned, down to the coal-tar enamel pipe coating, by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used must then be applied to the pipe. Following application of prime coat, wrap pipe with Scotchrap, Trantex V-10 polyvinyl tape, or approved equal. Tape must not be applied until prime coat is completely dry.

Tape must be spirally and tightly wrapped on each section of pipe with 50% lap. Wrap must be made to bell-on-bell end and to a point 6 in. from spigot end. Protect joint with tape 6 in. in width on pipe 12 in. or less in size, and 8 in. in width on pipe greater than 12 in. in size.

3.2.11. **Protective Coating and Wrapping on Joints**. All bolts and nuts installed for underground service on valves, fire hydrants, CI MJ fittings, pipe joints, and other ferrous metal appurtenances must be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint, including glands, flanges, bolt heads, and nuts, must be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote are not allowed. Coating and wrapping of joints will be considered part of the installation and will not be paid for directly.

3.2.11.1. **Steel Pipe Field-Welded Joints**. After installation of pipe, bends, and specials, all end of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted, or wrapped as specified for the pipe adjacent to the weld.

3.2.12. **Joint Assembly**.

3.2.12.1. **Rubber Ring Joints**. The installation of pipe and the assembly of rubber ring joints for DIP, CSC pipe, and AC pipe must conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars, known as "stabbing," is not permitted with pipe larger than 6 in. in size. Spigot ends of pipe larger than 6 in. in size must be properly inserted in the joint by means of suitable pushing or pulling devices.

3.2.12.2. **Mechanical Couplings**. Mechanical couplings must be assembled and installed in conformance with the standards recommended by the manufacturer. Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling, which must center it over the joint. After positioning, the nuts must be drawn up fingertight. Uniform pressure on the gaskets must be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning must be accomplished using a torque wrench and in a manner similar to the tightening procedure. The coupling must then be left undisturbed for 24 hr. to allow the gaskets to "pack in." Final torque check must then be made before coating and wrapping the joint. Table 24 sets forth the proper torque for various-sized mechanical couplings and is included for the convenience of the Contractor.

Table 24
Torque for Mechanical Couplings

Coupling Size (in.)	Bolt Diameter (in.)	Torque (ft.-lb.)
2–24	5/8	75
2–24	3/4	90
30 and 36 (1/4 × 7 middle rings)	5/8	65
30–36 (3/8 and heavier middle rings)	5/8	70
30–48	3/4	80
48–72	3/4	70

3.2.12.3. **Restrained Joints**. Install restraint joints as shown on the plans or as directed. Install in conformance with manufacturer's recommendations.

3.2.13. **GI and DI Fittings**.

3.2.13.1. **Fittings**. Fittings 6 in.–12 in. in size must be either MJ, push-on joint short body, or push-on joint compact body, unless otherwise stated on the plans. Fittings must be installed with the thrust blocking or joint restraint shown in Standard Drawing DD-839 series. Fittings 16 in.–24 in. in size must be MJ-type unless otherwise shown on the plans. Adaptors must be used where necessary to provide a transition between AC pipe and the fittings. Restraint or thrust blocking must be provided as shown on the plans or as directed. Anti-corrosion embedment is a part of all installed CI fittings and must be provided as specified. No separate payment will be made for this embedment.

3.2.13.2. **Cleaning DI**. All lumps, blisters, and excess coal-tar coating must be removed from the ends of DIP fittings. The outside of the spigot and the inside of the bell must be wire brushed and wiped clean, dry, and free of oil and grease before the pipe is laid. The interior of the pipe must be blown clean using compressed air or swabbed out clean and dry as directed. Immediately before placing any pipe in the trench, the interior must be cleaned using an approved brush or swab or compressed air to remove all dirt and foreign materials. All pipe and fittings must be inspected by the Contractor for defects while suspended above ground.

3.2.14. **Corrosion Protection for Ferrous Pipe, Fittings, and Valves**. Except as otherwise shown on plans or as directed, anti-corrosion embedment must be provided for all DIP, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced CSC pipe. The embedding material must be Modified Grade 5 gravel-washed sand in accordance with the requirements set forth in Section 7033.2.14.2., "Bedding and Initial Backfill for Water Mains."

Prepare the trench in accordance with applicable provisions of Section 7033.3.1., "Excavation." After subgrade has been prepared, lay pipe to grade in accordance with plans and Specification. Pipe, fitting, or valve must be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket must be 6 in. in every direction.

3.2.15. **Tie-In to Existing Mains**. The Contractor must make all ties to existing mains as shown on the plans or as directed. Contractor is responsible for shutdowns and isolation of existing main, coordinating with utility owner onsite before cutting pipe for connection, dewatering the excavation, customer notification of shutdown, proper material, and all other requirements as directed to provide completion in a safe and secure manner. Tie-ins must be completed as noted on the construction plans. During construction, planned shutdown and tie-in must be coordinated and approved. Planned shutdown and tie-in must be accomplished at a time that is at the least inconvenience to customers. No additional compensation will be provided for tie-ins accomplished after normal working hours. For tie-in to existing mains of AC pipe, the Contractor must observe and comply with all federal, state, and local laws, ordinances, and regulations regarding the management of asbestos-containing materials. At the minimum, work involving AC pipe should be overseen by a person who has received asbestos training and is familiar with the National Emissions Standards for Hazardous Air Pollutants. If greater than 260 ft. of pipe is to be removed, written notification to the Texas Department of State Health Services 10 days before commencing with the removal of AC pipe is required. At each location shown on the plans or identified by the Contractor to involve AC pipe, the Contractor is required to coordinate with the Department's contractor for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. The contractor must remove whole sections of AC pipe so that the Contractor can make the tie-in at the nearest joint. The contractor must remove the AC pipe, store it in a secure Engineer-approved location, and then dispose of it. Before requiring the services of the contractor, the Contractor must notify the Engineer and the owner of the utility of the work schedule a minimum of 2 weeks in advance of requiring such services to not delay the overall project. Delays or claims made by the Contractor, resulting from the failure to provide advance notification and schedule coordination with the Evergreen contractor, will not be a basis for additional compensation.

3.2.16. **Abandonment of Old Mains and Valves**. The Contractor must accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open

ends of abandoned mains and all other openings or holes in such mains caused by cutting or removal of outlets must be blocked off by manually forcing cement grout or concrete into and around the openings in enough quantity to provide a permanent substantially watertight seal.

Valves abandoned in the execution of the work must have the valve box and extension packed with sand to within 8 in. of the finished surface. The remaining 8 in. must be filled with 2,500-psi concrete or an equivalent sand-cement mix and finished flush with the adjacent pavement or ground surface. The valve covers must be salvaged and returned to the water system company. Abandoning old mains and valves is considered part of the installation and will not be paid for directly.

3.2.17. **Jacking, Boring, or Tunneling Pipe**.

3.2.17.1. **Jacking**. Suitable pits or trenches must be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways, or other facilities and must not weaken or damage such facilities. Barricades and lights must be furnished as directed to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided. The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of no more than 2 in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe depends on the character of the material, but it must not exceed 2 ft. in any case.

The pipe must be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade must be as shown on the plans or as determined by the Engineer.

Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

Excavation for boring pits and installation of shoring must be as outlined above. Boring operations may include a pilot hole that must be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade must apply as specified above.

3.2.17.2. **Tunneling**. Tunneling may be used when the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring. The excavation for pits and the installation of shoring must be as specified in Section 7033.3.2.17.1., "Jacking." The lining of the tunnel must be of the material shown on the plans.

Access holes for grouting annular space must be spaced a maximum of 10 ft.

3.2.17.3. **Joints**. Joints for pipe for jacking, boring, or tunneling must be as specified and shown on the project plans or shop drawings per pipe manufacturer's recommendation.

3.2.17.4. **Grouting of Bores or Tunnels**. Annular space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise specified on the plans.

3.2.18. **Cutting-In Valves**. The work involved in cutting a valve into an existing main must consist of excavation and backfilling with approved selected material; hauling and disposition of surplus excavation and other materials;

installation of the valve, valve box assembly, and all pipe cut used to complete cut-in; reaction blocking; and polyethylene wrapping where required.

3.2.19. **Tapping Sleeves and Valves**. Size-on-size taps are not permitted. The work involved in the installation of a tapping sleeve and valve must consist of excavation; backfilling the excavation with approved selected material; and installing the tapping sleeve, reaction blocking, tapping valve, valve box assembly, concrete collar where subjected to street traffic, and a CI lid. New taps are not permitted closer than 2 ft. of a joint or existing tap. The use of a shell-type cutter is required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach before start of work. The cutting edge must be sharp and round. Inspector will reject defective cutters.

Air-test tapping sleeves to 50 psi before tapping main line.

Place valve box in such a manner to prevent shock or stress from being transmitted to valve. Center valve box over valve operating nut with box cover flush with finished pavement surface or located at another level as directed. Valve boxes located in street or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Form collars around such valve boxes and finish off neatly and in a workmanlike manner.

3.2.20. **Cutting-In Tees**. The work involved in cutting in a tee must consist of excavation, shutdown, and isolation of existing main to which the new main is to be connected; cutting pipe for connection; dewatering the excavation; customer notification of service interruption where required; installation of all pipe used to complete the connection; all necessary tie-ins (connection to existing or new main); fittings; approved reaction blocking required; and backfilling the excavation with approved selected materials or flowable backfill if required. Where the installation of a valve is required, payment will be for valve in accordance with this Specification.

3.2.21. **Pipe Joint Restraint System**. Pipe joint restraints must be used to prevent movement for PVC push-on bell and spigot pipe connections. The restrainer may be adapted to connect a plain-end PVC pipe to a DI, MJ bell fitting. Joint restraint must be non-directional and installed to fully restrain system.

3.2.22. **Concrete Encasement, Cradles, Saddles, and Collars**.

3.2.22.1. **Concrete Encasement**. When concrete encasement is shown on the plans or when directed, the trench must be excavated and fine graded to a depth conforming to the details and sections shown on the plans. The pipe must be supported by pre-cast concrete blocks of the same strength as the concrete for encasement, and securely tied down to prevent flotation. Encasement concrete must be placed to a depth and width conforming to details and sections shown on the plans.

3.2.22.2. **Concrete Cradles**. When shown on the plans or when directed, concrete cradles must be constructed in conformance with details and sections shown on the plans. The trench must be prepared and the pipe supported in the same manner as described in this Specification. The strap or tie-downs must be No. 4-rebar diameter minimum or better as determined by the Engineer.

3.2.22.3. **Concrete Saddles**. When shown on the plans or when directed, pipe to receive concrete saddle must be backfilled in accordance with Section 7033.3.4., “Backfill,” to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

3.2.22.4. **Concrete Collars**. When shown on the plans or when directed, concrete collars must be constructed in conformance with details and sections shown on the plans.

3.3. **Fire Hydrants and Miscellaneous Appurtenances**.

3.3.1. **Fire Hydrants**. Hydrants must be connected to the main as shown on the plans or as directed. They must be installed in a manner that provides complete accessibility and in a sage location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb, the hydrant barrel must be set so that no portion of the hydrant is less than 12 in. or more than 7 ft. from the back of the curb.

When the hydrant is set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap may be within 6 in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the Contractor.

Hydrants must be set in conformance with plans, and details must be set plumb and have their nozzles parallel to or at right angles to the curb, with the pumper nozzle facing the curb. Drainage and concrete pad must be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit may be connected to a storm sewer or to a sanitary sewer.

3.3.1.1. **RJs**. Restrained MJs that require field welding or groove cuts into the pipe barrel for restraint will not be accepted. RJs must be furnished for pipe at all changes in direction as shown on plans or details, or as directed. Restrained MJs must be locked MJs. Joints must be capable of test pressure twice the maximum sustained working pressure of 350 psi for DIP and PVC.

3.3.1.2. **Replacing and Relocating Existing Fire Hydrants**. When existing fire hydrants must be replaced or relocated, the work must be accomplished by one of the following.

- Cutting or installing a tee of the size and type shown on the plans or as directed.
- Using a tapping sleeve and valve of the size and type shown on the plans to install a new fire hydrant to an existing or new water main. Size-on-size taps are not permitted.
- Relocating the existing fire hydrant by closing the existing fire hydrant, extending the fire hydrant branch, and installing the existing fire hydrant as specified.

Salvage the existing fire hydrant and other materials as designated in the field by the construction Inspector, and deliver to the utility owner's water system material storage yard. Fire hydrant branches must be abandoned by cutting and capping fire hydrant CI tee at the service main, and surface restored to its original condition.

After the fire hydrant has been set, paint hydrant with suitable primer and finish with oil-based aluminum paint from top of hydrant to a point 18 in.–20 in. below centerline of the pumper nozzle, and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting will be included in the unit cost for installing the fire hydrant.

Pipe, fittings, and valves used in the placement of fire hydrants and connections to the main must be considered part of the fire hydrant installation and not part of the main construction, and will not be paid for directly.

3.3.2. **Valve Boxes, Adjustments**. Valves must be provided with valve boxes, manholes, or valve pits as shown on the plans.

The valve box must be placed in such a manner to prevent shock or stress from being transmitted to the valve. It must be centered and set plumb over the operating nut of the valve with the box cover flush with the surface of the finished pavement, or at such other level as may be directed. Valve boxes located in streets or other areas subjected to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly.

Valve box must be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box must be set flush with the surface of the finished pavement or at

such other elevations as may be specified. Pits must be constructed to permit minor valve repairs and to afford protection to the valve and pipe from impact where they pass through the pit walls.

Existing valve boxes located within the limits of new street construction that are in conflict must be adjusted to match proposed finish grades.

Valve boxes installed as part of a new valve and mainline construction project are considered “new valves.” Adjustments to new valves are part of the installation of the valve. No separate pay will be given to adjust new valves to finished grade.

3.3.3. **Air Release Assembly**. Air release valves and appurtenant items must be installed at the locations shown on the plans unless otherwise directed.

Install air release assemblies in open trench as shown on the plans and details. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories, and appurtenances. They also include service line and tap to main. Air release assemblies installed in parkways or easements and outside street pavement must be installed as shown on plans.

Air release assemblies installed on steel pipe attached to bridge structure include the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories, and appurtenances.

3.3.4. **Blow-Offs**. Permanent and temporary blow-off assemblies must be installed at the locations shown on the plans or where otherwise directed. The permanent blow-off must consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans, and 6-in. valve box assembly including the 6-in. valve box and concrete collar around the valve box where subjected to vehicular traffic. The temporary blow-off must consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans. Valve box must be raised and installed to finished grade in conformance with details.

3.3.5. **Gate Valves**. Gate valve installation must include valve, reaction blocking when required conforming to plans, CI boot, valve box extension (DI riser pipe), valve box, concrete collar where subjected to vehicular traffic, and valve box lid. Gate valves constructed in terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems on all valves located between 6 ft. and 13 ft. Adjustable valve box and valve key extension systems must be centered over the valve’s operating nut, with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other area subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly.

Valve pits must be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box must be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits must be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact where penetrating through pit walls. In a high-pressure distribution system as specified in this Specification, all valves 6 in. and larger must be supported on a concrete pad as shown on the plans.

3.3.6. **Anchorage and Blocking**. Suitable reaction blocking or anchorage must be provided at all dead ends, plugs, caps, tees, crosses, valves, and bends as shown on the plans. All mechanical restraints must be bi-directional. Anchor blocks must be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust, except where this is not possible, as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be used in conjunction with blocking when shown on the plans or as directed.

Thrust blocking must be a minimum of Class A (3,000 psi) concrete placed between solid ground and the fitting, except as otherwise shown on the plans. The area of bearing in contact with solid ground must be as shown on the plans or as directed.

In all cases, the design of thrust blocking must be sized to withstand a soil pressure of 3,000 psf, unless specified otherwise in the job plans or Specifications. The maximum soil pressure value allowed for the design of thrust blocking is 5,000 psf. When soil pressure bearing values of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil in question must be submitted to the Engineer for verification.

The blocking must be placed so that pipe and fitting joints are accessible. Pipe polywrap must be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee must be poured separately from the block across the back of the tee. If they are poured simultaneously, a rigid partition must be placed between the blocks.

Valves 12 in. and larger in size must be supported on a concrete pad extending vertically from 12 in. below the bottom of the valve to the lower quarter point of the hub, laterally from face to face of hubs, and transversely from wall to wall of the trench.

3.4. **Backfill**.

3.4.1. **Initial Backfill**. Initial backfill is defined as backfill with a thickness in its compacted state from the surface of the bedding to a point 1 ft. above the top of pipe. The first lift of initial backfill must be inspected and approved before placement of the second lift. The second lift of initial backfill material must extend from the spring line of the pipe with a minimum of 1 ft. above the top of the pipe. The second lift must be evenly spread in a similar manner as the first lift.

For diameters 24 in. and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12-in. lifts to a minimum of 1 ft. above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, may be used for this purpose. The vibrator must be inserted every 3 ft. on each side of pipe.

3.4.2. **Secondary Backfill**. Secondary backfill is defined as backfill from 1 ft. above the top of pipe to the top of the trench. Secondary backfill must be constructed as shown in plans and these Specifications.

Secondary backfill material must be placed in maximum 12-in. loose lifts or as directed.

3.4.3. **Sand Backfilling of Cross-Trenches and Open Holes**. Blow-offs; tie-ins; air release valves; and service lines, meter boxes, or other specials must be backfilled with sand and thoroughly consolidated by saturating with water, unless otherwise directed. The use of mechanical tamping equipment for compaction of backfill is not permitted at such locations. Disposal of surplus excavated material and placement of sand is considered a part of trenching and backfilling and will not be paid for directly.

3.4.4. **Trench Backfill Across Traffic Arteries**. Any trench in or across traffic arteries must be backfilled immediately after the pipe is installed unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.4.5. **Flowable Backfill**. Instead of normal backfill materials, the Contractor must backfill the trench with flowable backfill with fly ash material at the locations shown on the plans or at locations directed. The flowable backfill material and operation must be in accordance with Item 401, “Flowable Backfill.”

3.5. **Flushing and Testing Mains**.

3.5.1. **Flushing**. Immediately upon completion of pipe laying, the Contractor must flush all mains. This flushing must be at the direction of the Engineer and must consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed.

The flow-through must continue until the Engineer determines all dust, debris, or foreign matter that may have entered during pipe-laying operations has been flushed out. The new line must then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses must be used to direct flushing water from the main into suitable drainage channels or sewers.

3.5.2. **Operation of Valves**. No valve in the distribution system may be operated by the Contractor without prior permission. The Contractor must notify the owner when a valve is to be operated and must operate the valve only in the presence of the Engineer's representative.

3.5.3. **Hydrostatic Tests**. Except in high-pressure sections of the water distribution system where test pressures will exceed 150 psi, all new mains must be hydrostatically field tested at a maximum test pressure of 150 psi before approval. Where designated as high-pressure area, all new mains must be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance. All joints that are found to leak by either observation or during any test must be made watertight by the Contractor. In case repairs are required, the hydrostatic field test must be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests that meet specified requirements will be paid in conformance with the unit price for the hydrostatic pressure test. No payment will be made for tests that fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but before chlorination and replacement of pavement, it must be filled with water for a minimum of 24 hr. and then subjected to a hydrostatic pressure test. The specified test pressure must be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus, including gauges and meters, must be furnished by the Contractor. Unless otherwise specified, the water system company must furnish water for filling lines and making tests through existing mains.

Before applying the specified test pressure, all air must be expelled from the main. To accomplish this, taps must be made, if necessary, at the points of highest elevation and afterward tightly plugged at no cost to the Department. At intervals during the test, the entire route of the new main must be inspected to locate any leaks or breaks. If any are found, they must be stopped or repaired. The test must be repeated until satisfactory results are obtained.

The hydrostatic test must be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test must be a minimum of 4 hr. for new mains in excess of 1,000 ft. and a minimum of 1 hr. for new mains less than 1,000 ft. after the main has been brought up to test pressure. The test pressure must be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests must be continued until the Engineer is satisfied that the new main meets the requirements of these Specifications. Should any test of pipe in place disclose leakage greater than listed in Table 25 or Table 26, the Contractor must, at their expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valve section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor must notify the Engineer before beginning the test, and the water system company's inspector must be present during the pressure test.

PVC pipe leakage allowances must conform to DI leakage allowances listed in Tables 25 and 26.

Table 25
Hydrostatic Test Leakage Allowance (Max) at 150 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons per Hour (gph)[2]													
	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1,000 ft.	2,000 ft.	3,000 ft.	4,000 ft.	5,000 ft.
6" DI[1]	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	2.20	3.30	4.40	5.50
8" DI[1]	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47	2.94	4.41	5.88	7.35
12" DI[1]	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	4.40	6.60	8.80	11.00
16" DI[1]	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94	5.88	8.82	11.76	14.70
20" DI[1]	0.39	0.74	1.10	1.47	1.84	2.21	2.55	2.94	3.31	3.68	7.63	11.04	14.72	18.40
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79	1.58	2.37	3.16	3.95
24" DI[1]	0.44	0.88	1.32	1.76	2.21	2.65	3.09	3.53	3.97	4.41	8.82	13.23	17.64	22.05
24" CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.90	2.85	3.80	4.75
30" DI[1]	0.55	1.10	1.66	2.21	2.76	3.31	3.86	4.42	4.97	5.52	11.04	16.56	22.08	27.05
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	2.36	3.54	4.72	5.90
36" DI[1]	0.66	1.32	1.99	2.65	3.31	3.97	4.63	5.30	5.96	6.62	13.24	19.86	26.48	33.10
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42	2.84	4.26	5.68	7.10
42" DI[1]	0.77	1.54	2.32	3.09	3.86	4.63	5.40	6.18	6.95	7.72	15.44	22.16	30.88	38.60
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66	3.32	4.98	6.64	8.30
48" DI[1]	0.88	1.77	2.65	3.53	4.42	5.30	6.18	7.06	7.95	8.83	17.66	26.16	35.32	44.15
48" CSC	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89	3.78	4.98	6.64	8.30
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	–	–	–	–	–
60" CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16	–	–	–	–	–

1. PVC pipe must be tested to DI pressures. DIP includes MJs and push-on joints.
2. Gallons per hour (gph) for CSC pipe is manufacturer's maximum.

Note—Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

Table 26
Hydrostatic Test Leakage Allowance (Max) at 200 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons per Hour (gph)[2]									
	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.	600 ft.	700 ft.	800 ft.	900 ft.	1,000 ft.
6" DI[1]	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8" DI[1]	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12" DI[1]	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16" DI[1]	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20" DI[1]	0.43	0.85	1.28	1.40	2.13	2.55	2.98	3.40	3.83	4.25
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79
24" DI[1]	0.51	1.02	1.53	2.4	2.55	3.06	3.57	4.08	3.59	5.10
24" CSC	0.10	0.19	0.29	0.358	0.48	0.57	0.67	0.76	0.86	0.95
30" DI[1]	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
30" CSC	0.12	0.24	0.35	0.474	0.59	0.71	0.83	0.94	1.06	1.18
36" DI[1]	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42" DI[1]	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48" DI[1]	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19
48" CSC	0.19	0.38	0.70	0.76	0.95	1.13	1.32	1.51	1.70	1.89
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
60" CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30

1. PVC pipe must be tested to DI pressures. DIP includes MJs and push-on joints.
2. Gallons per hour (gph) for CSC pipe is manufacturer's maximum.

Note—Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

3.6. **Disinfection of New Mains Using Machine Chlorination**. After the new mains have successfully passed the pressure test specified in Section 7033.3.5.3., "Hydrostatic Tests," the Contractor must disinfect those

mains shown on the plans or otherwise indicated as "Machine Chlorination." This disinfection must include chlorination, flushing, and placing the mains in service. All other disinfection requirements must be accomplished by the Contractor. Disinfection by the Contractor is limited to sections of pipe less than 800 ft. in length between sections.

3.6.1. **Operation of Valves**. During and after the disinfection of mains, the Contractor will be notified enough in advance to enable the Contractor to have a competent representative present whenever valves are to be operated that will affect the pressure in any part of the work for which the Contractor is responsible.

3.6.2. **Contractor's Personnel and Equipment**. The Contractor must supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.6.3. **Safeguarding and Backfilling Open Holes**. The Contractor is responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor must backfill such holes in accordance with appropriate provisions of Section 7033.3.4., "Backfill."

3.6.4. **Disinfection of Mains Using Dry Calcium Hypochlorite (HTH)**. Mains must be disinfected with dry HTH where shown on the plans or as directed and must not exceed a total length of 800 ft. This method must also be followed for main repairs. Contractor must use appropriate safety measures to protect personnel during disinfection operation.

3.6.5. **Dosage**. The Contractor must disinfect the new or replaced mains with HTH of 70% available chlorine. Enough HTH must be used to obtain a minimum chlorine concentration of 50 parts per million (ppm). Table 27 is included for the convenience of the Contractor.

Table 27
Chlorine Dosage

Diameter of Pipe (in.)	Ounces per Foot to Obtain 50-ppm Chlorine Dosage
6	0.0138
8	0.0233
10	0.0364
12	0.0523
14	0.0708
16	0.0934
18	0.1175
20	0.1455
24	0.2080
30	0.3270
36	0.4690
42	0.6370
48	0.8330
54	1.0575
60	1.308

A heaping tablespoon holds approximately 1/2 oz., and a standard measuring cup holds approximately 8 oz.

3.6.6. **Filling the Main**. Those sections of main to which dry HTH has been applied must be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves must be under the direction of the Engineer in accordance with Section 7033.3.5.2., "Operation of Valves."

3.6.7. **Holding Time**. The length of time for which sections of main disinfected with HTH must be allowed to stand undisturbed depends on the particular job and TCEQ criteria.

When circumstances permit a shutdown with no customers out of service, the required minimum detention time must be 24 hr. with a 50-ppm chlorine dosage.

When customers are out of service during a shutdown with no leakage past valves, the required minimum detention time must be 3 hr. and the chlorine dosage must be 300 ppm.

When customers are out of service during a shutdown with some leakage past valves, the required minimum detention time must be 30 min. with a 500-ppm chlorine dosage.

3.6.8. **Flushing**. Following the expiration of the specified holding time, the treated section of main must be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 7033.3.5., "Flushing and Testing Mains." Flushing must continue until no chlorine remains detectable by taste or odor, or until the chlorine residual is less than 0.3 ppm. The Contractor must make provisions for the disposal and runoff of the flushing operations to minimize erosion or impact on residents.

3.6.9. **Preventing Reverse Flow**. Valves must be manipulated so that the strong chlorine solution in the line being treated is flushed out of the main and does not flow back into the line supplying the water.

3.6.10. **Supervision**. All disinfection must be completed as directed.

3.6.11. **Additional Treatment**. Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment must be as directed. If further disinfection is required, chlorination must be completed in accordance with Section 7033.3.6., "Disinfection of New Mains Using Machine Chlorination." In no case, however, will the new line be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the standards of TCEQ.

If an open hole is unsafe and does not have proper trench protection, owner's chlorination crew must not chlorinate project until acceptable trench protection is provided.

3.6.12. **Safeguarding and Backfilling Open Holes**. The requirements for safeguarding and backfilling all holes excavated or left open for chlorinating and sampling are as specified in Section 7033.3.6.3, "Safeguarding and Backfilling Open Holes."

3.7. **Service Supply Lines**. Service supply lines and fittings, meter boxes, and appurtenances must conform to material specifications and must be installed by the Contractor as specified, or as directed and as shown on the plans.

3.7.1. **Designation of Service Supply Lines**. A service supply line located between the water main and the inlet side of the water meter is designated as a "water service line." A service supply line located between the outlet side of the water meter to the point of connection within the limits of the customer's lot or property is designated as "customer's yard piping." Services 2 in. and smaller are designated "small services"; services 4 in. and larger are designated "large services."

3.7.2. **Service Relays**. New transfer mains to which services are to be relayed and are on the same side of the streets as the customer's meter are defined as "short relays." New transfer mains to which services are to be relayed and are on the opposite side of the street from the customer's meter are defined as "long relays."

New transfer mains to which services are to be reconnected and on the same side of the street as the old main are defined as "service reconnects."

Existing services on the opposite side of the street to the new main are defined as a "long relay."

3.7.3. **Service Relocates**. "Service relocates" are defined as services that are relocated from an alley to a side or front street. New transfer mains to which services are to be relocated and are on the same side of the street as the customer's new meter box location are designated as "short relocates." New transfer mains to which services are to be relocated and are on the opposite side of the street from the Customer's new meter box location are designated as "long relocates."

3.7.4. **New Services.** If a new main is required to be extended to provide water service for new customers, the service lines laid to the new main will be designated as “new services.” New laid mains to which new services are on the same side of the street as the customer's new meter box location are designated as “new short services.” New laid mains to which new services are on the opposite side of the street from the customer’s new meter box location are designated as “new long services.”

3.7.5. **New Unmetered Services**. “New unmetered services” are defined as services that are installed on existing mains or new mains to provide service to customers’ platted vacant lots. Where the new main or existing main to which new unmetered services are being installed on the same side of the street as the customer’s new or existing meter box location (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated “new unmetered short services.” Where the new main or the existing water main to which new unmetered services are installed is on the opposite side of the street from the customer’s new or existing meter box location (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated “new unmetered long service.” New unmetered long services and new unmetered short services must not include “customer’s yard piping,” and no meter may be set.

3.7.6. **Tap Holes**. “Tap holes” are defined as excavations at existing mains, which are required in association with replacements of water service lines by pulling, boring, or jacking operations.

All backfill material must be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill, and secondary backfill will be included in the various sizes of each service placed.

3.7.7. **Service Line Installation**. Unless otherwise notified, service relays, service reconnects, service relocates, and new services must be installed as described, and as shown on the plans. Unless otherwise indicated, existing meter and meter box relocation must be included in the service line installation.

All service line installation must include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown on the plans.

Cutting, excavation, backfill, and replacement of pavement must be completed as specified and in accordance with applicable Sections of this Specification and the Contract documents. The minimum trench width for small service lines must be 8 in., while the minimum trench width for large service lines must be the nominal pipe diameter plus 16 in., except when specified otherwise. For 3/4-in. to 2-in. service lines, minimum bury depth must be 3 ft. For services greater than 2 in., minimum depth of bury must be 4 ft.

All service lines must be installed as shown in the plans and Specifications, except that two strap service saddle clamps must be installed for all tap connections made on water mains located within boundaries of Pressure Zones (formally known as Service Levels) 9–16.

The Contractor must use precaution to protect and preserve the polyethylene wrap around DI water mains when installing service corporations. The required method is to wrap pipe tape around the pipe, over the polywrap, and in the area to be tapped. The tap must be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe and corporation, and the first 3 ft. of the service, must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

Small service lines must be embedded in sand in accordance with the Specification.

Where approved by the construction Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor must isolate the new service line by closing the curb stop or angle valve until the meter box is set.

3.7.8. **Splicing**. A long service line single splice may be permitted by means of a three-part compression or flared coupling only when approved in advance, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed. Splicing short service lines is not permitted.

3.7.9. **Boring or Jacking Service Lines**. Service lines that cross paved streets may be installed at the Contractor's option by boring or jacking operations. Where it becomes necessary to widen the main trench section to accommodate a bore pit, such widening must not extend more than 1 additional foot into the traffic side of the street.

3.7.10. **Tapping AC Water Mains**. All necessary service line tapping of AC pipe must be completed during the period immediately before or after hydrostatic pressure testing operations so that subsequent flushing maximizes the elimination of contaminants associated with the tapping process.

Tapping of AC pipe must be completed in compliance with manufacturers' recommendation and completed using only tap machine with a built-in flush valve, and the flush valve must be open during the entire procedure.

3.7.11. **Abandonment of Service Lines**. The Contractor must accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated on the plans as "tap plug" and "tap kill." The corporation stop for an abandoned service line tapped on a ferrous main must be removed, and the tap at the main must be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop must not be removed from the main. Instead, the corporation stop must be closed, and the flared nut must be removed from the corporation stop. After the appropriately sized copper disc is inserted inside the flared nut, replace the flared nut on the corporation stop. The Contractor must salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the owner.

3.7.12. **Tapping PVC (C-900)**. Tapping of PVC must be completed in compliance with Uni-Bell procedures. Direct tapping is not allowed. All drill-cutting tools must be the "shell type," with internal teeth or double slots that must retain the coupon.

The shell cutters must be designed for C-900 pipe, thus with enough root depth to handle the heavier-walled pipe.

3.7.13. **Small Service Lines**. Copper tubing must be used for 3/4-in.–2-in. service lines. Brass fittings for 3/4-in. and 1-in. service lines must be of the flared or compression type for use with Type K soft annealed copper tubing. Brass fittings for 1-1/2 in. and 2-in. lines must be of the flared or compression type for use with Type K soft annealed copper tubing, except as modified by this Specification.

Copper tubing must be cut squarely using an approved cutting tool and avoiding excessive pressure on the cutting wheels, which might bend or flatten the pipe walls. Following the copper tubing cut but before flaring, a reamer must be used to remove the inside rolled lip from the tubing. Flared ends must be expanded using a flaring tool, taking care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings must be straight for at least 10 in. Bending of tubing must be accomplished using an appropriately sized bending tool. No kinks, dents, flats, or crimps are permitted, and should such occur, the damaged section must be cut out and replaced. When compression fittings are used, the copper tubing must be cut squarely before insertion into the fitting final assembly and must be in compliance with the manufacturer's recommendations.

3.7.14. **Small Service Lines on New Mains**. Installation of new copper service lines must consist of:

- all excavation through miscellaneous material encountered;
- trench excavation protection;
- drilling and tapping the new main using an approved tapping machine;
- setting the curb stop or angle valve at the meter;

- laying the new copper service line at the specified depth between the main and the meter and its tie-in at the corporation and the curb stop or the angle valve;
- relocating the existing meter and installing a new meter box where required in accordance with this Specification;
- backfilling the trench with approved selected material and disposal of surplus excavated material;
- capping the tap hole with asphalt-treated base, including the outer limits of the main trench line with service line trench; and
- cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench, and the completed service line trench.

3.7.15. **Reconnecting Service Lines**. Both old and new water mains at existing service line connections as shown on the plans must be exposed. The old main must be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main must be exposed for the purpose of being drilled and tapped using an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose enough length of the existing service line to provide slack to bend it to position for tying to the new corporation stop. After suitable notification to the customer, the Contractor must "kill" the existing service by closing the corporation stop, removing the existing flare nut, inserting the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous. The Contractor must then immediately open the stop and restore water service to the customer. Where it is not possible to obtain enough length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor must splice the necessary length of new tubing and tie it to the existing service by means of a compression coupling at a point as close as practicable to the new main.

Cutting and bending of the tubing, introduction of slack to compensate for soil movement, and completion of the installation must be as specified in this Specification.

Where old and new mains are on opposite sides of the street, service lines may be installed under the street pavement by boring rather than trenching.

3.7.16. **Relaying Service Lines**. The existing or new mains shown on the plans must be exposed opposite location stakes placed onsite at the direction of the Engineer. The existing or new main must be drilled and tapped using an approved tapping machine, a new corporation stop installed, and the trench extended laterally to the location specified for the meter box. The existing meter must be reset, and the meter box and base must be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location must not vary more than 24 in. in any direction from its staked location. The service line must be installed with sufficient slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line must be extended from the main to the existing meter, and a new curb stop installed at the end of the service line and connected to the inlet side of the meter. If disturbed, the existing meter box must be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching.

3.7.17. **Single Service Line—Dual Meters**. The single service line—dual meter installation must consist of a 1-in. copper service line reducing to two 3/4-in. copper service lines at a tee that must be set in line with the front edge of meter boxes for 5/8-in. and 3/4-in. meters. A single service line with dual meters must be installed in those new residential developments where new 5/8-in. and 3/4-in. meters are required and in main replacement work where it is necessary to change the location of existing 5/8-in. and 3/4-in. meters. Single service line—dual meter materials and installation requirements must be in accordance with the requirements of this Specification.

3.7.18. **Small Service Lines on Existing Mains**. The work involved in the installation of new copper service lines on existing mains must consist of:

- jacking; boring; tunneling; and, where authorized, open trench operations, with all excavation through whatever material encountered;

- trench excavation protection;
- using the existing corporation when approved;
- tapping the existing main, installing the new corporation, and setting the curb stop or angle valve at the meter;
- relocating the existing meter and installing a new meter box where required in accordance with this Specification;
- abandoning the existing corporation stop; removing the existing flared nut; and inserting inside the existing flared nut an appropriately sized copper disc and replacing the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous;
- installing the new service line at the same grade as the existing service line or at the specified grade between the main and the existing meter and its tie-in at the corporation and the curb stop;
- disposal of surplus excavated material;
- capping the tap hole with asphalt-treated base, including the outer limits of the main line trench and the service line trench;
- cutting and replacing all surfaces of whatever type encountered over the completed service line trench; and
- restoration of the site.

3.7.19. **Large Service Lines**. DIP and CI fittings used for metered service lines and non-metered fire service lines larger than 2 in. must be installed in accordance with the applicable provisions of this Specification, except where otherwise approved.

3.7.20. **Large Service Lines on New Mains**. Work involved in the installation of new metered service lines and non-metered fire service lines must consist of:

- all excavation through whatever material encountered;
- trench excavation protection;
- installing tees, pipe, and fittings of various sizes, including main line and service line valves, valve boxes, DIP, and fittings, as shown on the plans and reaction block required;
- backfilling with approved selected material; and
- cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.7.21. **Large Service Lines on Existing Mains**. The work involved in the installation of the new metered service lines and non-metered fire service lines must consist of:

- all excavation through whatever material encountered; trench excavation protection; cutting in tees and installing tapping sleeves and valves; and pipe and fittings of various sizes, including main line and service valves;
- valves boxes, DIP, fittings, and reaction block required;
- backfilling with approved selected material; and
- cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.7.22. **Meter Boxes**. Physical movement of existing meters and meter boxes to new locations may be required where service lines are transferred to new mains in conjunction with main replacement work. Unless specified otherwise, the Contractor must move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC Schedule 80 must be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers must be salvaged and returned to the owner by the Contractor. The Contractor must also replace the salvaged meter boxes with the new, appropriately styled oval plastic meter box with oval cover, or rectangular meter box. Unless otherwise specified, the old service line must be abandoned after the existing meter has been reset in the existing or new meter box.

Where meter boxes are installed in sidewalks or driveways, the Contractor must install a No. 1 meter box (two pieces) as shown in the Specification and plans.

New meters must be set by the owner where mains are extended and new services lines are installed for new or initial customer service. Instead of the new meter, the Contractor must furnish and install a meter template as shown on the plans.

Meter and meter box configuration must have the meter set horizontal, approximately 6 in. below the top of meter box, so that the meter is above the bottom of the meter box and in line with the meter box lid opening. The top of the meter box must be flush with the existing ground surface. All excess soil above the meter coupling, meter flange, and meter nuts inside the meter box must be removed so that the meter register is clearly visible. The Contractor must exercise special precautions during excavation at the existing meter location to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor must raise the existing meter to conform to the correct configuration indicated. Adjustment of meter to proper grade is a part of the construction and will not be paid for separately.

Where required, pressure-reducing valves must be installed by the customer in accordance with the Uniform Plumbing Code and must be placed beyond the outlet side of the meter, but not within the owner's meter box. The pressure-reducing valve must be the property of the water user responsible for its installation, maintenance, and replacement as required.

The meter box adjustment must not exceed 10 ft. from the existing box.

3.7.23. **Water Service for Fire Lines**.

3.7.23.1. **Start of Work**. Three working days' notice must be given to the assigned Inspector before start of a project after permit has been issued. The Contractor must start their work at a tie-in or point designated. Pipe must be laid with bell ends facing in the direction of laying, unless otherwise authorized or directed. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades, with fittings, valves, and hydrants placed at the required locations. Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed. No valve or other control on the existing system may be operated for any purpose by the Contractor unless a representative of the utility owner is present.

3.7.23.2. **Crossing Other Underground Lines**. New fire line services crossing any other utilities must have a minimum of 48 in. of cover over the top of the pipe, unless otherwise waived or modified. Excavation around other utilities must be completed by hand for at least 12 in. all around. Any damage to other utilities must be reported to their proper governing entity.

3.7.23.3. **Pipe Grade**. Fire line services must have a minimum of 48 in. of cover for mains 16 in. and below, and 60 in. for mains 20 in. and above, over the top of the pipe, unless otherwise waived or modified. Pipe grades must be as required by the plans or as directed. Grades must be met as specified. Precautions must be taken to ensure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length, except at couplings. Couplings must not be in contact with the original trench bottom before backfilling. Modified Grade 5 material must be placed under the coupling and compacted by hand before backfilling to provide an even bearing surface under the coupling and pipe. Changes in grade must be made only at joints.

3.7.23.4. **Modified Grade 5 Materials**. Before placing pipe in a trench, the trench must have been excavated to the proper depth as required by these Specifications. Approved imported materials or Engineer-approved materials selected from suitable fines derived from the excavation must be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.7.23.5. **Structures to Support Pipe**. If the bottom of a trench at subgrade consists of material that is deemed notably unstable and cannot be removed and replaced with approved material, subgrade may be properly compacted in place to support the pipe. The Contractor must also construct a foundation for the pipe consisting of piling, concrete beams, or other supports as shown on the plans prepared.

3.7.23.6. **Lowering Materials into Trench**. Satisfactory implements, tools, and facilities must be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench piece by piece, by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water service materials and protective coatings and linings. Under no circumstances may water service materials, pipes, and fittings be dropped or dumped into the trench. Extreme care must be taken to avoid damaging polywrap films. No chains or slings are allowed, unless the entire sling is wrapped with a protective nylon web sock.

3.7.23.7. **Laying of Pipe**. Every precaution must be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions or as otherwise required, a heavy, tightly woven canvas bag of suitable size must be placed over each pipe.

The canvas bag must be left in place until a connection is made to the adjacent pipe. The interior of each pipe must be inspected for defects, and the pipe must be rejected if any defects are found.

After placing a length of pipe in the trench, the jointed end must be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements of these Specifications. The pipe must be secured in place with approved backfill material tamped around it. Pipe and fittings that do not allow enough uniform space for joints must be rejected and must be replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is halted, the open end of pipe in the trench must be closed by a watertight plug or other approved means. Pipe in the trench that cannot temporarily be joined must be capped or plugged at each end to make it watertight. This provision must apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal must remain in place until the trench is pumped completely dry. The Contractor must provide all plugs and caps of the various sizes required.

3.7.23.8. **Deviations in Line or Grade**. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to an extent that an alteration on the plan is required, the Construction Inspector has the authority to change the plans and direct a deviation from the line and grade, or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. Any deviation from the line must be accomplished using appropriate bends, unless such requirement is specifically waived.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed by the Construction Inspector and as described. In no case may the amounts exceed those shown in Table 22 for DIP.

3.7.23.9. **Cutting Pipe**. The cutting of pipe for inserting valves, fittings, or closure pieces must be accomplished in a neat manner to produce a smooth end at right angles to the axis of the pipe. The recommendations of the pipe manufacturer must be strictly followed by the Contractor. Under no circumstances may a worker not equipped with proper safety goggles, helmet, and all other required safety attire be permitted to engage in this work.

3.7.23.10. **AC**. No field cutting is allowed on AC pipe. Installation of fire line services to AC pipe mains must be accomplished in accordance with Section 3.2.15., “Tie-In to Existing Mains.”

3.7.23.10.1. **Joint Assembly**.

3.7.23.10.1.1. **Rubber Ring Joints**. The installation of pipe and the assembly of rubber ring joints for DIP must conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars, known as "stabbing," is not permitted. Spigot ends of pipe must be properly inserted in the joint by means of suitable pushing or pulling devices or a manufacturer-approved method.

3.7.23.10.1.2. **Mechanical Couplings**. Mechanical couplings must be assembled and installed in conformance with the standards recommended by the manufacturer.

Mechanical coupling consists of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring is flared at each end to receive the wedge-shaped gasket, which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling, which must center it over the joint. After positioning, the nuts must be drawn up fingertight. Uniform pressure on the gaskets must be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning must be accomplished using a torque wrench and in a manner similar to the tightening procedure after 15 min.

3.7.23.10.1.3. **RJ**. RJs must be installed as shown on the plans or as directed by the Construction Inspector. Installation must conform to the manufacturer's recommendations.

3.8. **Installation of Non-Metallic Pipe Detection System**. The non-metallic pipe detection system must be installed concurrently with the proposed pipe placement. Tracer wire must be used for location purposes and taped directly to the pipe. The tracer wire must be solid-core (14-gauge insulated) and must taper to the main in 10-in. increments. Wire must also come up to the top of valve extensions and fire hydrant stems, as directed.

3.9. **High-Pressure Zone**. Work performed for construction of a high-pressure water distribution system, including water mains, services, fire hydrants, and all related appurtenances, must be completed in accordance with this Specification. This Section applies solely to the construction of high-pressure water systems and governs when in conflict with other Sections of this Specification.

3.9.1. **High-Pressure Systems**. Each water distribution system that furnishes water in Pressure Zone 9–16 must be designated as a high-pressure system. The static water pressure in each service level must be no less than 35 psi nor exceed 175 psi with no fire hydrants in use.

3.9.2. **Locations of High-Pressure Levels**. Geographically, boundaries of Pressure Zone 9–16 are in accordance with the surface contour tabulation shown in Table 28. Most of the area within Pressure Zone 9–16 is located north of Loop 1604 between IH-35 North and Bandera Road.

Table 28
High-Pressure Levels

Static Gradient Service Level	Max Ground Elevation (ft.)	Ground Elevation (ft.)	Ground Elevation 110 psi (ft.)	Ground Elevation 150 psi (ft.)	Ground Elevation175 psi (ft.)
9	1,125	1,000	870	780	720
10	1,290	1,160	1,040	940	880
11	1,400	1,270	1,150	1,050	1,000
12	1,520	1,390	1,270	1,170	1,120
14	1,630	1,500	1,380	1,280	1,230
15	1,860	1,730	1,600	1,510	1,460
16	1,990	1,860	1,740	1,640	1,590

4. MEASUREMENT

This Item will be measured as follows: “Pipe Water Main (DI),” “Pipe Water Main (PVC),” “Pipe Water Main (PVC Casing) (Open Cut),” and “Pipe Water Main (Steel Casing) (Open Cut).” Water pipe of the various sizes as shown on the plans will be measured by the foot as follows: From the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run.

Between the centerline intersections of runs and branches of tees and where the branch is plugged for future connection, the measurement will include the entire laying length of the branch or branches of the fitting.

The measurement of each line of pipe of each size must be continuous and must include the full laying lengths of all fittings and valves installed between the ends of such line, except that the laying lengths of reducers must be divided equally between the connected pipe sizes. Lines leading to a tapping connection with an existing main will be measured to the center of the main tapped.

“Fire Lines” will be measured by the foot for each size and type from the centerline intersection of the fire line with the main distribution line to the property line. The measurement will include the entire laying length of the branch or branches of the fitting and valves. Line leading to a tapping connection with an existing main will be measured to the center of the main tapped.

“Jacking or Boring (Water Main)” will be measured by the foot of bore or tunnel as measured from face to face of jacking pits.

Carrier pipe used in bores and tunnels or backed into place will be measured by the foot of pipe installed from end to end of pipe to the limits as shown on the plans.

Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the foot installed as shown on the plans.

“Butterfly Valve and Box (Complete)” will be measured as each assembly of the various sizes installed.

“Gate Valve and Box (Complete)” will be measured as each assembly of the various sizes installed to finished grade.

“Cut-in Gate Valve and Box (Complete)” will be measured as each assembly of the various sizes installed to finished grade.

“Tapping Sleeve, Valve and Box (Complete)” will be measured as each assembly of the various sizes installed.

“Cut-in Tee (Complete)” will be measured as each assembly of the various sizes of CI tees cut in to the existing water main.

“Adjust Existing Valve Box” will be measured as each assembly adjusted to correspond to finish grade.

“Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars” for pipe will be measured by the cubic yard of accepted work. Reinforcing, if required, will not be measured for payment.

“Fire Hydrant with 6 in. Valve and Box” will be measured as each fire hydrant installed. Also included will be enough pipe, valve, and fittings.

“Relocate Fire Hydrant” will be measured as each fire hydrant relocated.

“Replace Fire Hydrant” will be measured as each fire hydrant replaced.

"Permanent Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

"Temporary Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

"Automatic Air Release Valve (Complete)" will be measured as each assembly of the size installed.

"Trench Excavation Protection" and "Joint Trench Excavation Protection" will be measured by the foot along the centerline of trench where the depth of trench exceeds 5 ft.

"Tie-In (Complete)" will be measured as each of the various sizes and types completed.

"New Short Service" will be measured as each of the various sizes and types of new service lines installed.

"New Long Service" will be measured as each of the various sizes and types of new service lines installed.

"New Unmetered Short Service" will be measured as each of the various sizes and types of new unmetered service lines installed.

"New Unmetered Long Service" will be measured as each of the various sizes and types of new unmetered service lines installed.

"Reconnect Short Service" will be measured as each of the various sizes of service lines reconnected.

"Reconnect Long Service" will be measured as each of the various sizes of service lines reconnected.

"Relay Short Service" will be measured as each of the various sizes of service lines re-laid.

"Relay Long Service" will be measured as each of the various sizes of service lines re-laid.

"Relocate Short Service" will be measured as each of the various sizes of service lines relocated.

"Relocate Long Service" will be measured as each of the various sizes of service lines relocated.

"Relocate Existing Meter and Existing Meter Box" will be measured as each assembly relocated and customer's service reconnected.

"Relocate Existing Meter and New Meter Box" will be measured as each assembly relocated and customer's service reconnected.

"Cut and Replace Concrete Sidewalk, Driveway, etc." will be measured by the square yard of surface area of the concrete sidewalk cut and replaced, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Cut and Replace Concrete Sidewalk (Asphalt)" will be measured by the square yard of surface area of concrete sidewalk to be cut and replaced with temporary asphalt (4-in. depth, Type C) pavement, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Cut and Replace Asphalt Pavement" will be measured by the square yard of surface area of the asphalt pavement cut and replaced, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Concrete Curb" will be measured by the foot of the concrete curb cut and replaced, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Cut and Replace Asphalt Pavement with 6-in. Asphalt Treated Base" will be measured by the square yard of surface area of the asphalt pavement cut and replaced with 6-in. of asphalt-treated base, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Hydrostatic Pressure Test" will not be measured for payment but will be considered a part of the various related bid items.

"Excavation" will not be measured for payment but will be considered a part of the pipe installation.

"Flowable Backfill" will be measured by the cubic yard in accordance with Item 401, but not to exceed the minimum trench width specified in Section 7033.3.1.2., "Width of Trench," or as shown on the plans.

"Installation of the Nonmetallic Pipe Detection System" will not be measured for payment but will be considered a part of the pipe installation.

"Removing and Replacing Chain-Link and/or Wire Fence" will be measured by the foot of fence removed and replaced, regardless of the type or height of the fence. The existing fence materials may be reused unless the existing materials were damaged during removal and should not be reused; the Contractor must provide new material for the replacement work at their expense.

"Ductile Iron and Gray Iron Fittings" will be measured by the weight to the nearest one-hundredth of a ton of the various sizes of fittings installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work after described. These prices are full compensation for furnishing and hauling all materials; for placing or installing the materials; for inspection and testing; and for all other items of material, labor, equipment, tools, and incidentals necessary to complete the work in accordance with the plans and Specifications.

Payment for "Pipe Water Main (DI)," "Pipe Water Main (PVC)," "Pipe Water Main (PVC Casing) (Open Cut)," and "Pipe Water Main (Steel Casing) (Open Cut)" will be made at the unit price bid per foot of pipe of the various sizes installed by the open-cut method. This payment will also include selected bedding, excavation, backfill materials (except for cement-stabilized backfill), polyethylene sleeve, and hauling and disposition of surplus excavated materials.

Payment for "Fire Lines" installed will be made at the unit price bid for pipe of various sizes installed. Such payment will include excavation-selected embedment material, backfill (except for cement-stabilized backfill), compaction of trench backfill, testing of compaction, tie-in, polyethylene sleeve where required, hauling, disposing of surplus excavated material, and restoration of surface. All replacement mains must include tie-in costs for existing fire lines.

Payment for "Jacking or Boring (Water Main)," jacking, boring, or tunneling will be made at the Contract unit price bid per foot of jacking, boring, or tunneling, which is full compensation for furnishing all materials (except carrier pipe, casings, or liners), labor, tools, equipment, and incidentals necessary to complete the work, including excavation, grouting, backfilling (except for cement-stabilized backfill), restoration to original ground conditions, and disposal of surplus materials.

Carrier pipe used in bores or tunnels will be paid for at the Contract unit price bid for "Carrier Pipe for Jacking, Boring, or Tunneling" per foot of pipe installed and measured as prescribed above.

Casings or liners used in bores or tunnels will be paid for at the Contract unit price bid for "Casing or Liner for Jacking, Boring or Tunneling" per foot of casing or liner installed and measured as prescribed above.

Payment for “Gate Valve and Box (Complete)” and “Tapping Sleeve, Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment also includes selected embedment material; anti-corrosion embedment when specified; concrete collar at the valve box where subjected to vehicular traffic; DI riser pipe; CI boot; packing; tarpaper; concrete grout; concrete reaction blocking; asphaltic material for bolts, nuts, and ferrous surfaces; polyethylene sleeve; hauling; and disposition of excavated surplus material and backfill where required. For butterfly valves only, such payment also includes mechanical or transition couplings and coated and wrapped steel pipe nipples required to complete the connection.

Payment for “Cut-in Gate Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This payment includes backfill, installation of valve, valve box assembly, all pipe cut and used to complete cut-in, reaction blocking, and polyethylene sleeve where required.

Payment for “Cut-in Tee (Complete)” will be made at the unit price bid for each of the various sizes of CI tees cut in to DI and CI mains. This payment also includes necessary tie-ins; protective coating for bolts, nuts, and ferrous surfaces; selected embedment material; anti-corrosion embedment when specified; backfill; pipe; fittings; polyethylene sleeve when required; concrete reaction blocking; and site restoration.

Payment for “Adjust Existing Valve Box” will be made at the unit price bid for each valve box adjusted to finish grade.

Payment will be made at the unit price bid for “Concrete Encasement, Concrete Cradles, Concrete Saddles, and Concrete Collars” by the cubic yard of concrete placed. Reinforcing, if required, will not be measured for payment.

Payment for “Fire Hydrant with 6 in Valve and Box,” “Relocate Fire Hydrant,” and “Replace Fire Hydrant” will be made at the unit prices bid for each such assemblies installed. These payments include backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling, disposition of excavated surplus material where required, asphaltic material for ferrous surfaces, concrete reaction blocking, concrete pad restoration of existing fire hydrant sites, and installing a new fire hydrant as directed.

Payment for “Permanent Blow-off (Complete)” and “Temporary Blow-off (Complete)” will be made at the unit price bid for each such assembly installed as shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open-cut method. These payments also include excavation, anti-corrosion when specified, the housing and disposition of surplus excavated materials, and approved selected backfill.

Payment for “Automatic Air Release Valve (Complete)” will be made at the unit price bid for each assembly of the various sizes installed as shown on the plans. This payment also includes selected embedment material; anti-corrosion embedment when specified; excavation, hauling, and disposition of surplus excavated materials; blocking; and various sizes and types of meter boxes.

Payment for “Gray Iron Fittings” and “Ductile Iron Fittings” will be made at the unit price bid for each ton of fittings of all sizes and types installed and will be based on the weights of fittings shown in Table 29. Such payment also includes excavation; selected embedment material; anti-corrosion embedment when specified; hauling and disposition of surplus excavated materials; polyethylene sleeve; asphaltic material for ferrous surfaces; all glands, nuts, bolts, and gaskets; and concrete reaction and thrust blocking. If compact fittings are not manufactured and other fittings are installed, Contractor must provide quantities and unit weights with pay request.

Weight tables are estimated quantities and can be verified by vendor information. Payments will be made by the lesser of the two (weights vs. supplier) at the Inspector’s discretion.

Payment for “Trench Excavation Protection” and “Joint Trench Excavation Protection” will be made based on the unit price bid for each foot of “Trench Excavation Protection” and “Joint Trench Excavation Protection” in place. Payment includes all components of the trench protection system, which can include, but not be limited to, sloping, sheeting, trench boxes, or trench shields; sheet piling; cribbing; bracing; shoring; dewatering; or diversion of water to provide adequate drainage. Payment also includes the additional excavation and backfill required, any jacking, jack removal, and removal of the trench support after completion, and is full compensation for all other labor, materials, tools, equipment, and incidentals necessary to complete the work.

Payment for “Tie-In (Complete)” will be made at the unit price bid for each tie-in of the various sizes and types completed. This payment includes shutdown and isolation of the existing main to which the tie is to be made, cutting pipe for connection, dewatering the excavation, and customer notification of service interruption where required. Connections between new and existing mains that are made using tapping sleeves and valves by cutting in tees will be as a no-separate pay item.

Payment for “New Short Service” and “New Long Service” will be made at the unit price bid for each new service line of the various sizes and types installed. This payment includes reconnection of new service to the existing meter and the adjustment of the meter, meter box, and customer valve. Such payment also includes excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement, and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or DIP (4 in. and larger).

Payment for “New Unmetered Short Service” and “New Unmetered Long Service” will be made at the unit price bid for each new unmetered service line of the various sizes and types installed. This payment includes excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper tubing or DIP (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

Payment for “Reconnect Short Service” and “Reconnect Long Service” will be made at the unit price bid for each service line of the various sizes and types reconnected. This payment includes excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, copper tubing or DIP (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.

Payment for “Relay Short Service” and “Relay Long Service” will be made at the unit price bid for each service line of the various sizes and types re-laid. This payment includes reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper tubing or DIP (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.

Payment for “Relocate Short Service” and “Relocate Long Service” will be made at the unit price bid for each service line of the various sizes relocated. This payment includes sand backfill, meter box relocation where required, copper tubing or DIP (4 in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.

Payment for “Relocate Existing Meter and Existing Meter Box” will be made at the unit price bid for each assembly relocated. This payment also includes excavation protection, hauling and disposition of surplus excavated materials, sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the relocated existing meter and existing meter box, and the existing yard piping.

Payment for “Relocate Existing Meter and New Meter Box” will be made at the unit price bid for each assembly relocated. This payment also includes sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the relocated existing meter and new meter box, and the existing yard piping.

Payment for the No. 1 meter box installation in sidewalks and driveways will be made in the amount difference between the standard meter box and the No. 1 meter box.

Payment for “Cement Stabilized Backfill” will be made at the unit price bid for each cubic yard of cement-stabilized backfill placed, but not to exceed the minimum trench width shown on the plans, per Item 400.

Payment for “Cut and Replace Concrete Sidewalk, Driveway, etc.” will be made at the unit price bid.

Payment for “Cut and Replace Asphalt Pavement” will be made at the unit price bid.

Payment for “Cut and Replace Asphalt Pavement with 6 in. of Asphalt Treated Base” will be made at the unit price bid.

Payment for “Cut and Replace Concrete Sidewalk (Asphalt)” will be made at the unit price bid.

Payment for “Concrete Curb” will be made at the unit price bid.

No direct payment will be made for “Hydrostatic Pressure Test.” Such test includes all materials and equipment required to conduct the test. This work and materials will be considered a part of the various related bid items.

Payment for “Flowable Backfill” will be made at the unit price bid for each cubic yard of flowable backfill placed, but not to exceed the minimum trench width shown on the plans, per Item 401.

Payment for “Removing and Replacing Chain-Link and/or Wire Fence” will be by the unit price bid per foot of fence removed and replaced.

No direct payment will be made for concrete blocking of water mains; coating and wrapping pipe joints; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; abandonment of water mains and valves; resetting existing meters and meter boxes in proper configuration; salvaging fire hydrants, valve boxes, and meter boxes; flushing water mains; and disinfection of water mains. This work will be subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the non-metallic pipe detection system. This work and materials will be subsidiary to the various pay items. In addition, the Contractor must ensure that the detection system is complete and operational to the satisfaction of the Engineer.

No direct payment will be made for furnishing and installing the pipe joint restraint system. This work and materials will be subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the joint restraint system for PVC C-905. This work and materials will be subsidiary to the various pay items.

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.

Table 29
Weights of GI and DI Fittings (lb.)

BENDS							
1/4 Bend (90°)				1/8 Bend (45°)			
Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57

BENDS							
1/4 Bend (90°)				1/8 Bend (45°)			
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580

BENDS							
1/16 Bend (22.5°)				1/32 Bend (11.25°)			
Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (in.)	MJ Compact (C153)	MJ (C110)	FLG SB
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

TEES						TEES				
Size (in.)		Weight				Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body		Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53		24	6	466	1,035	1,089
4	3	31	78	54			8	487	1,047	1,060
	4	33	80	60			12	539	1,075	1,125
6	4	49	114	90			16	625	1,109	1,070
	6	60	124	98			20	729	1,504	1,510
8	4	65	163	155			24	785	1,617	1,685
	6	76	175	148		30	8	739	1,808	–
	8	89	188	179			12	800	1,842	1,801
12	4	99	316	322			16	959	1,885	–
	6	115	325	297			20	1,026	1,941	–
	8	127	339	346			24	1,228	2,496	2,475
	12	162	407	369			30	1,373	2,531	2,615
16	6	226	536	573		36	24	1,548	2,710	2,255
	8	240	565	555			30	1,901	3,545	3,000
	12	283	615	590			36	2,012	3,686	3,160
	16	326	676	635		42	24	2,272	3,690	3,245
20	6	344	750	773			30	2,512	4,650	4,125
	8	273	766	720			36	3,048	5,119	5,360
	12	427	799	816			42	3,225	6,320	5,580
	16	503	975	950		48	24	2,934	4,995	4,385
	20	566	1,068	1,005			30	3,147	5,140	4,455
							36	4,046	6,280	5,555
							42	4,249	8,130	7,195
							48	4,469	8,420	7,385

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

CROSSES						CROSSES				
Size (in.)		Weight				Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body		Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	34	70	–		24	6	566	1,025	–
4	3	42	90	–			8	578	1,085	1,045
	4	46	105	–			12	610	1,153	1,110
6	4	63	140	–			16	663	1,256	1,200
	6	74	160	160			20	975	1,733	1,675
8	4	88	185	185			24	907	1,906	1,835
	6	97	205	205		30	8	650	1,795	–
	8	105	239	234			12	870	1,925	1,865
12	4	114	340	–			16	900	1,950	–
	6	135	360	360			20	1,220	2,060	–
	8	151	382	385			24	1,497	2,776	2,675
	12	199	493	495			30	1,808	3,188	3,075
16	6	250	590	575		36	24	1,853	2,928	2,980
	8	270	619	605			30	2,580	3,965	–
	12	332	685	–			36	2,698	4,370	4,370
	16	409	811	790		42	24	2,415	3,910	–
20	6	358	760	–			30	2,920	5,040	–
	8	379	822	790			36	3,788	5,835	–
	12	413	883	860			42	3,908	6,493	7,145
	16	550	1,117	1,085		48	24	3,435	5,210	–
	20	598	1,274	1,230			30	4,145	5,495	–
							36	4,873	6,790	–
							42	5,465	8,815	–
							48	5,588	9,380	–

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

CAPS			PLUGS	
Size (in.)	MJ Compact (C153)	MJ (C110)	MJ Compact (C153)	MJ (C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

SOLID SLEEVES				
Size (in.)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1,005

SOLID SLEEVES				
Size (in.)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

CONCENTRIC REDUCERS			
Size (in.)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1,042	1,459
36	24	785	1,580
36	30	655	1,868
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750

Table 29 (continued)
Weights of GI and DI Fittings (lb.)

2" TAPPED TEES AND CROSSES				OFFSETS		
	Weight				Weight	
Size (in.)	MJ Compact (C153)	MJ (C110)		Size (in.)	MJ Compact (C153)	MJ (C110)
4	24	47		4 × 6	35	75
6	36	71		4 × 12	55	83
8	54	97		6 × 6	35	110
10	69	130		6 × 12	67	138
12	87	169		6 × 24	96	189
20	–	259		8 × 6	82	164
24	–	320		8 × 12	98	209
				8 × 24	141	280
				12 × 6	121	320
				12 × 12	178	420
				12 × 24	240	645
				20 × 12	–	1,025
				20 × 24	–	1,245

Special Specification 7049
Water Mains

1. DESCRIPTION

Furnish labor, materials, and equipment necessary to provide a complete water main system in conformance with the plans and specifications, and in compliance with the Department's Utility Accommodations Policy (Title 43, T.A.C., Sections 21.31-21.55). Construct water mains of the sizes, materials, and dimensions shown on the plans including pipe, joints, and connections to new and existing pipes, casing, valves, fittings, fire hydrants, meters, blocking, etc., as many as may be required to complete the work.

Furnish material and equipment for encasing existing water lines with split steel encasement pipes using the open cut method in accordance with this specification.

The abbreviations AWWA, ASA, ASTM, ANSI, AASHTO, NACE, NSF, SSPC, and TCEQ used in this specification refer to the following organizations or technical societies:

- AWWA American Water Works Association
- ASA American Standards Association
- ASTM American Society for Testing and Materials
- ANSI American National Standards Institute
- AASHTO American Association of State Highway and Transportation Officials
- NACE National Association of Corrosion Engineers
- NSF National Sanitation Foundations
- SSPC Steel Structural Painting Council
- TCEQ Texas Commission on Environmental Quality

References to specifications of the above organizations mean the latest standard or tentative standard in effect on the date of the proposal.

2. MATERIALS

All materials must conform to the requirements of this Item, the plans and the following Items:

- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 465, "Junction Boxes, Manholes, and Inlets"
- Item 471, "Frames, Grates, Rings, and Covers"

2.1. **General.** Provide new and unused materials for this project unless otherwise stated in the plans or proposal.

Pipe 6 in. or larger is acceptable to the Texas Fire Insurance Commission without penalty for use in water works distribution systems.

For water mains less than 24 in. in diameter, use casing insulators between the water main and casing unless otherwise shown on the plans. For water mains 4 in. through 14 in., use 8 in. wide casing insulators.

For water mains 16 in. through 20 in., use 12 in. wide insulators. For pipe materials up to 12 in., use Pipeline Seal and Insulator Model C8G-2 or approved equal. For water mains larger than 12 in. use Pipeline Seal and

Insulator Model C12G-2 or approved equal. Casing end seals: Pipeline Seal and Insulator Model C or approved equal.

2.2. **Steel Pipe and Fittings.**

2.2.1. **Steel Carrier Pipe.** Provide steel pipe for use as carrier pipe in the distribution system, conforming to the requirements of AWWA Standard C200. Install steel pipe 20 in. and smaller as aerial crossings, above-ground piping, and for encasement sleeves only. Do not bury steel pipe that is 20 in. and smaller directly or within a casing.

For pipe 24 in. and greater, conform to the requirements of AWWA C200, C207, C208 and AWWA M11 except as modified in this specification. Furnish pipe and fittings that have manufacturer's certifications ensuring that they have been hydrostatically tested at the factory in accordance with AWWA C200, Section 3.4. Ensure pipe steel meets the requirements of ASTM A36, ASTM A570 Grade 36, ASTM A53 Grade B, ASTM A135 Grade B, or ASTM A139 Grade B as a minimum. Pipe is also subject to the requirements of Underwriters Laboratories, Inc. Specification for “Steel Pipelines for Underground Water Service.”

Provide pipe and fittings to withstand the most critical simultaneous application of external loads and internal pressures based on the minimum of AASHTO HS-20 loading, AREMA E-80 loads, depths of bury as indicated on the plans, and the most critical groundwater level condition. The pipe design conditions follow:

- Working pressure = 100 psi.
- Hydrostatic field test pressure = 150 psi.

For pipe design (24 in. and larger) conform to AWWA M11 with the following conditions:

- Design stress due to working pressure: The maximum is 50% of the minimum yield strength or 16,500 psi maximum stress for mortar-coated pipe.
- Design stress due to hydraulic test pressure: The maximum is 75% of the minimum yield strength or 24,750 psi maximum stress for mortar-coated pipe.
- Modulus of soil reaction (E'), <1,500 psi.
- Unit weight of fill (w) > 120 pcf.
- Deflection lag factor (D1) = 1.2.
- Bedding constant (K) = 0.1.
- Fully saturated soil conditions: hw = h = depth of cover above top of pipe.
- Maximum deflection from specified diameter = 3% for flexible coatings.

Provide pipe and fittings that have been designed by a licensed Engineer. Before manufacturing, submit these signed, sealed, and dated calculations for approval.

Supply pipe in double random lengths unless otherwise shown on the plans. Bevel the ends of the pipe for field butt welding as shown on the plans.

Provide a minimum of 3/8 in. inside joint recess between ends of pipe in straight pipe sections.

Provide a minimum allowable steel wall thickness in accordance with Tables 1 and 2 for HS-20 live loads and depths of bury up to 16 ft.

Table 1
Carrier Pipe (20 in. and Smaller)

Nominal Pipe Size (in.)	Outside Diameter (in.)	Min Wall Thickness (in.)	Approximate Weight Per Lineal Ft., Uncoated (lb.)
4	4.500	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.750	0.365	40.48
12	12.750	0.375	49.56
16	16.000	0.375	62.58
20	20.000	0.375	78.60

Table 2
Carrier Pipe (24 in. and Larger)

Net Inside Diameter (in.)	Min Wall Thickness (in.)	
	Flexible Coating	Mortar Coating
24	0.149	0.136
30	0.149	0.136
36	0.178	0.163
Note: Refer to the plans for carrier pipe thickness. However, never use a pipe wall thickness less than that defined in the above tables.		

2.2.2. **Steel Casing Pipe.** Ensure pipe intended for use as casing pipe is manufactured in accordance with Section 2.2.1, "Steel Carrier Pipe," except to ensure that the minimum allowable steel wall thickness conforms to those shown in Table 3 for HS-20 live loads and depth of bury of up to 16 ft.

Table 3
Casing Pipe (Encasement Sleeves)

30 in. and Smaller			
Casing Pipe Size (in.)	Outside Diameter (in.)	Min Wall Thickness (in.)	Approximate Weight Per Lineal Ft., Uncoated (lb.)
8	8.625	0.219	19.64
10	10.750	0.219	24.60
12	12.750	0.219	29.28
16	16.000	0.219	36.86
18	18.000	0.250	47.39
20	20.000	0.250	52.73
24	24.000	0.250	63.41
30	30.000	0.250	79.43
Note: Refer to the plans for casing thickness. However, never use a pipe wall thickness less than that defined in the above table.			

Provide steel casing sections for split casing in lengths a maximum of 20 ft. Ensure each section is split in half-sections. Bevel the ends and split sections for field butt-welding.

Steel casing pipe is not required to carry the label of the Underwriters Laboratories, Inc.

2.2.3. **Steel Pipe Fittings.** Provide factory forged steel pipe fittings unless otherwise shown on the plans. Ensure the wall thickness is equal to or greater than the pipe to which the fitting is to be welded. Bevel the ends of the fitting for field butt-welding.

Provide approved sleeve-type flexible and flange adaptor couplings. Ensure the thickness of the middle ring is equal to or greater than the thickness of the pipe wall.

Provide restraint joint connections for 16 in. and larger water main piping shown on the plans to have restraint lengths, unless otherwise shown on the plans. Joints are to be double-welded at butt or lap joints at aerial crossings as shown on the plans. Use flanged joint at valves.

Elbows: Provide 2-piece for 0° to 22.5°; 3-piece for 23° to 45°; 4-piece for 46° to 67.5°; and 5-piece for 68° to 90°, unless otherwise shown on plans.

Outlets: Reinforced in accordance with AWWA M11, Sections 13.3-13.7, AWWA C200, and AWWA C208. Provide interior lining and exterior coating in accordance with paragraphs on coating and lining, and matching pipe to access inlets, service outlets, test inlets, and air-vacuum valve and other outlets, including riser pipes.

Radius: The minimum radius is 2.5 times pipe diameter.

2.2.4. **Hydrostatic Test of Pipe.** Ensure the pipe manufacturer performs hydrostatic testing in accordance with AWWA C200, Section 3.5.3, at the point of manufacture, conducts the test for a minimum of 2 min., and thoroughly inspects the pipe. Repair or reject pipe revealing leaks or cracks. Obtain from the manufacturer and submit to the Engineer, the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

Calibrate pressure gauges within 1 yr. before testing, as specified in AWWA C200, Section 1.04 L.

2.2.5. **Butt Straps for Closure Piece.** Provide a minimum 12 in. wide split butt strap; minimum plate thickness equal to the thinnest member being joined; fabricated from material equal in chemical and physical properties to the thinnest member being joined.

Provide a minimum lap of 4 in. between the member being joined and the edge of the butt strap, welded on both the inside and outside, unless otherwise approved.

Provide a minimum 6 in. welded outlet for inspecting each closure section, unless the access man way is within 40 ft. of the closure section. Provide forged steel threaded outlets of approved design, where required, for use in passing hose or lead wires into the pipe. Tap plugs with standard pipe threads and weld to the pipe in an approved manner, and use solid forged steel plugs for closure.

Provide full penetration butt or welded joints as shown on the plans. Use flanged joints at valves unless otherwise shown on the plans. Perform x-ray or ultrasonic testing of manual welds on special pipe and fittings.

Dished Head Plugs: Provide dished head plugs (test plugs) to withstand field hydrostatic test pressure from either side of the plug. Ensure the design stress due to hydrostatic pressure is at most 50% of minimum yield. Pipe on the opposite side of the hydrostatic test may or may not contain water. Ensure the manufacturer of the steel pipe hydrostatically tests the plugs at the factory.

Make curves and bends by deflecting joints, by using beveled joints, or by combining these methods, unless otherwise shown on the plans. Do not exceed the joint deflection angle recommended by the pipe manufacturer.

Make penetration of spigot into bell at all points of circumference at least equal to minimum required penetration shown on the plans. Provide beveled pipe sections used in curved alignment of standard length except when shorter sections are required to limit the radius of curvature. In this case, provide equal length sections throughout the curve. Do not allow the bevel to exceed 5°.

2.2.6. **Steel Pipe Flanges.** Ensure steel pipe flanges shown on the plans conform to AWWA Standard C207 for Class D Flanges (same diameter and drilling as Class 125 cast-iron flanges ASA B16.1).

Make cast-iron to steel pipe connections with 1 cast-iron bell flange and 1 steel slip-on flange, and ensure they are electrically isolated.

The use of insulating gaskets, plastic bolt sleeves, and washers of insulating gasket material backed with zinc plated or hot-dip galvanized washers, or epoxy coated bolts, nuts, and washers used with an insulating gasket, are approved for this purpose.

For inline flange joints 12 in. in diameter and greater and for butterfly valve flanges, use Pyrex LineBacker Type E phenolic gaskets manufactured by Pipeline Seal and Insulator Inc., or approved equal.

Use full-face gaskets for other flanged joints not listed above. Provide cloth-inserted rubber gasket material, 1/8 in. thick in accordance with AWWA C207. Ensure gaskets are factory-cut to proper dimensions.

Maintain electrically isolated flanged joints between steel and cast-iron by using epoxy coated bolts, nuts, washers, and insulating type gaskets unless, otherwise approved.

Fabricate flanges with oversize bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2.2.7. **Steel Pipe Protective Coatings.**

2.2.7.1. **General.** Use shop-applied protective coatings except for field repairs and coatings of field welded joints. The Engineer may provide for witness of inspection and testing of shop-applied coatings, however, such witness does not relieve the Contractor of the responsibility to furnish material, perform work, and provide quality control in conformance with the applicable AWWA Standard and the requirements of these specifications.

The substrate surface profile and minimum and maximum individual and total dry film thickness (DFT) indicated in this specification apply. No requirement of this specification cancels or supersedes the specific written directions and recommendations of the specific coating manufacturer so as to jeopardize the integrity of the applied system. Measure the dry film thickness in accordance with SSPC PA2.

Field test shop coating and field repairs for holidays, pinholes, or discontinuities, at voltage levels required by the applicable AWWA Standard and in accordance with the applicable NACE procedure, i.e., PRO 188, RPO 274, TMD 384, etc. Submit the test procedure, including voltage levels to be used, before testing. Repair holidays in conformance with the applicable AWWA Standard.

Provide documentation by a NACE-certified inspector of compliance with the required tests.

Handle, store, and use field procedures for shop-coated pipe in conformance with the applicable AWWA Standards. Adequately seal and protect pipe ends from damage during handling and storage. Do not remove such protection until immediately before installing. Do not lift pipe using caliper clamps or hooks at ends of the pipe.

Repair damage to the pipe or the protective coating caused while installing the pipe and before final acceptance by the owner, as directed and in conformance with the applicable standards.

Keep the interior of the pipe and fittings clean of foreign matter before installing and until the work is accepted. Keep joint contact surfaces clean until jointing is complete.

Furnish an affidavit of compliance that all materials and work furnished comply with the requirements of the applicable AWWA Standard and these specifications.

2.2.7.2. **Internal Lining for Steel.** Ensure the material used for the internal coating of the steel carrier pipe is NSF61-listed as suitable for contact with potable water as required by Chapter 290, Rules & Regulations for Public Systems, Texas Commission on Environmental Quality (TCEQ).

Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than 140°F. Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61, and certification from an organization accredited by ANSI. Unless otherwise noted,

coat exposed (wetted) steel parts of flanges, blind flanges, bolts, and access manhole covers, with epoxy lining as specified.

2.2.7.2.1. **Epoxy Lining.** Use Liquid Epoxy meeting the requirements of AWWA C-210, "Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines," except as modified in this specification. Provide a Liquid Epoxy system consisting of three coats of polyamide epoxy (no coal tar material) as follows:

- Prime Coat: 2-part, chemically cured, NSF certified epoxy, 4-6 mils dry film thickness (DFT).
- Intermediate Coat: 2-part NSF certified epoxy, 4-6 mils (DFT).
- Finish Coat: 2-part NSF certified epoxy, 4-6 mils (DFT).

Ensure the total system has a minimum DFT of 12 mils and a maximum DFT of 18 mils. Apply each coat in contrasting colors, using a buff prime and intermediate coat and a white finish coat. Use the same manufacturer to supply all material. Coal-tar epoxy material is not permitted. For surfaces to be coated, abrasive blast clean them to a near-white finish in accordance with SSPC-5(64) to establish an average anchor profile of 2.0 to 3.0 mils, with no individual reading greater than 4.0 mils or less than 1.5 mils. Before applying, inspect the prepared and cleaned surface for evidence of non-visible contaminants such as soluble salts or chlorides in accordance with NACE Technical Committee Report "Surface Preparation of Contaminated Steel Surfaces," NACE Publication 6G 186.

Re-clean the surface as necessary, until it is free of such contaminants.

Perform an interior adhesion test on pipe 30 in. in diameter and larger in accordance with ASTM D 4541.

Minimum field adhesion: 700 psi. Perform this test on pipe for project at a frequency of one for every 1000 sq. ft. of epoxy lining. Perform a cure test in accordance with ASTM D 4752 (solvent rub test) and ASTM D 3363 (pencil hardness) for each section of pipe. Repair tested areas with approved procedures.

Provide Fusion Bonded Epoxy in accordance with AWWA C-213, "Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines."

2.2.7.3. **External Coating.**

2.2.7.3.1. **Above Ground.** Externally coat above ground steel piping and fittings with a 3-coat epoxy/epoxy/polyurethane system in accordance with AWWA C-218, "Coating the Exterior of Aboveground Steel Water Pipelines and Fittings," Section 2.5, Coating System No. 4-91, except as modified in this specification.

- Prime Coat: 2-component, inhibitive epoxy primer; DFT of 4-6 mils.
- Intermediate Coat: 2-component, chemical resistant epoxy; DFT of 4-6 mils.
- Finish Coat: 2-componant aliphatic polyurethane; DFT 1.5-2.5 mils.

Ensure the total system has a minimum DFT of 9.5 mils and a maximum DFT of 14.5 mils. Apply each coat in contrasting colors, using a buff prime coat and a blue finish coat, or as directed. Use the same manufacturer to supply all material. For surfaces to be coated, abrasive blast clean them to a near-white finish in accordance with SSPC-SP10 (NACE 2) to establish an average anchor profile of 2.0 to 3.0 mils, with no individual reading greater than 4.0 mils or less than 1.5 mils. Before coating, inspect the prepared and cleaned surface for evidence of non-visible contaminants such as soluble salts or chlorides in accordance with NACE Technical committee Report "Surface Preparation of Contaminated Steel Surfaces," NACE Publication 6G 186. Re-clean the surface as necessary, until it is free of such contaminants.

Perform an interior adhesion test on pipe 30 in. in diameter and larger in accordance with ASTM D 4541. Minimum field adhesion: 700 psi. Perform this test on pipe for the project at a frequency of one for every 1000 sq. ft. of epoxy lining. Perform a cure test in accordance with ASTM D 4752 (solvent rub test) and ASTM D 3363 (pencil hardness) for each section of pipe. Repair tested areas with approved procedures.

Provide Fusion Bonded Epoxy in accordance with AWWA C-213, “Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.”

2.2.7.3.2. **Buried Steel Pipe, 24 Inch Diameter and Larger Only.** Coat buried steel pipe and fittings (except tunneled, cased, or augered holes) with either of the following systems:

2.2.7.3.2.1. **Tape Coating.** Provide an approved tape for external tape coating. Apply in accordance with AWWA C214 and the requirements of this section; 80 mil shop-applied, Polyken YG-III, Tek-Rap Yard-Rap, or approved equal. Components: Primer, one 20 mil layer of inner-layer tape for corrosion protection and two 30 mil layers of outer-layer tape for mechanical protection. Bond coupling to adjacent pipes with bonding cables as shown on the plans.

Use approved filler putty, type Polyken 939 insulating putty, or approved equal, to fill in the gap and create a smooth sloped transition between the top of the reinforcing plate and the pipe, before applying the tape coating.

Primer: Compatible with the tape coating, supplied by the coating-system manufacturer.

Provide pipe with shop coatings cut back approximately 4 to 4-1/2 in. from the joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1 in. staggers to facilitate field wrapping and welding of joints. Inner and outer tape width: 12 in. or 18 in.

Do not expose tape coating to direct sunlight for more than 60 days.

Wrap specials and fittings that cannot be machine wrapped due to configuration, with primer layer and two layers of prefabricated tape, each 35 mils thick. Overlap machine applied tape with hand applied tape by minimum of 2 in. and bind to it.

Apply Polyken approved 30 mil filler tape 931, or approved equal, parallel to spiral weld seams if weld height measures greater than or equal to 1/8 in.

2.2.7.3.2.2. **Polyurethane Coating.** Refer to Section 2.2.7.3.1., “Above Ground.” Heat Shrink Joint Sleeves for Tape Coating: Aqua-shield, or approved equal. For repairs to heat shrink joint sleeves, use Aqua-shield Repair Patch Kit, or approved equal.

2.2.7.3.3. **Steel Pipe in Tunneled, Cased, Bored, or Augered Holes.**

2.2.7.3.3.1. **24 Inch and Larger:** Prime steel pipe in tunneled or cased holes with 3.0 to 4.0 mils of a 2-part chemically cured rust inhibitive polyamide epoxy. Prepare the surface the same as for above ground external coating in accordance with Section 2.2.7.3.1., “Above Ground.” Fill the annular space between the tunnel or casing with the specified grout.

2.2.7.3.3.2. **20 Inch and Smaller:** Coat steel pipe in bored or augered holes, or holes in a tunnel or casing, with Corropipe II-TX or Corroclad 2000 as manufactured by Madison Chemical Industries, Inc., or approved equal, and apply in strict conformance with the manufacturer's recommendations.

For external field welds and other field repairs, use Madison Chemical “GP” II or “TX” Touch Up, or approved equal, in conformance with the manufacturer's recommendations.

2.2.7.4. **Inspections and Testing of Coatings.** Perform electrical inspection on the inner layer of tape before applying the intermediate layer of tape. If holidays are detected, repair holidays immediately before applying the outer layer of tape. Clear the holiday area of material and re-prime if necessary. Re-coat the area with inner wrap tape. Overlap the inner wrap tape onto the surrounding inner wrap coating by at least 2 in. Perform an electrical re-test at the repaired area after repairing the holiday, and before continuing the outer wrap.

Shrink Wrap: Perform an electrical inspection on the shrink wrap to check for holidays. Perform peel tests over the heat affected zone. Minimum acceptable result: 15 lbs. ft. per inch.

2.3. **Ductile-Iron Pipe and Fittings.**

2.3.1. **Ductile-Iron Pipe.** Provide ductile-iron pipe conforming to the requirements of AWWA Standard C151. Provide minimum lengths of 18 ft. and minimum thickness of Class 51 for water lines. Provide minimum thickness Class 53 for flanged pipe and minimum thickness Class 52 for areas with pipe offset sections. Use joints of the push-on type or flanged type unless otherwise shown on the plans. Use push-on joints conforming to the requirements of ASA Specification A21.11 (AWWA C111). Use flanged joints conforming to the requirements of AWWA C115 including a cloth inserted rubber gasket material 1/8 in. thick for flanged joints. Do not use threaded or grooved type joints which reduce the pipe wall thickness below the minimum required.

Provide polyethylene encasement material and install in accordance with AWWA C105, and backfill as specified. Apply a minimum of two complete wraps of 8 mil thick polyethylene. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a tunnel or casing, provide polyurethane coating.

Ensure the pipe manufacturer performs hydrostatic testing in accordance with AWWA C 151, Section 5.2.1, at the point of manufacture, conducts the test for a minimum of 2 min. and thoroughly inspects the pipe. Repair or reject pipe revealing leaks or cracks. Obtain from the manufacturer and submit to the Engineer, the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

Prevent any lateral movement of thrust restraints throughout the pressure testing and operation. Passive resistance of soil will not be permitted in the calculation of thrust restraint.

Clearly mark the pipe section to show the location and thickness or pressure class color code.

Provide an exterior coating, in open cut excavations, consisting of a prime coat and an outside asphaltic coating conforming to AWWA C110, C115, or C151 for pipe and fittings. Encase the water line in a double wrap of polyethylene. Use polyethylene wrap conforming to the requirements of Section 2.13., "Polyethylene Film Wrap," and Section 3.16., "Polyethylene Film Wrap." Install bond wire as specified.

Coat Ductile-Iron pipe in augered holes with a polyurethane coating. Use a polyurethane coating conforming to the same requirements as those in Section 2.2.7.3.3., "Steel Pipe in Tunneled, Cased, Bored, or Augered Holes."

2.3.2. **Fittings for Ductile-Iron Pipe.** Ensure fittings for use with ductile-iron pipe of nominal sizes 4 in. through 48 in. conform to AWWA Standard C110 or C153.

Use joints of the push-on type or flanged type unless otherwise shown on the plans. Use push-on joints conforming to the requirements of ANSI Specification A21.11 (AWWA C111), rated for a 250 psig working pressure or A21.53 (AWWA C153). Use flanged fittings conforming to AWWA C110, of cast or ductile iron and conforming to ANSI B16.1, class 125 rated at 250 psig working pressure. Screw flanged fittings on threaded pipe ends done in the shop in accordance AWWA C115 for attaching, aligning, and facing.

Coat the inside and outside surfaces of the fittings as specified for the regular lengths of ductile-iron pipe.

Regardless of the coating system, for flanged joints in buried service, provide a petrolatum wrapping system, Denso, or approved equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

Bond joints in accordance with Section 2.6., "Joint Bonding and Electrical Insulation."

2.3.3. **Restrained Joints.** For buried services, restrain ductile iron pipe 16 in. diameter and larger from movement, using special joints. Provide the following or approved equal:

- Super-Lock Joint by Clow Corporation.
- Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
- TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company.

Provide restrained joints with enough distance from each side of the bend, tee, plug, or other fitting to resist thrust developed at the design pressure for the pipe.

Use water main interior coatings conforming to AWWA C104 or ANSI A21.4, cement-lined with seal coat or ANSI A 21.16 fusion-bonded epoxy coating.

Ensure the material used for internal coating is NSF 61 and listed as suitable for contact with potable water as required by Chapter 290, Rules and Regulation for Public Water Systems, Texas Natural Resources Conservation Commission (TNRCC).

2.4. **Polyvinyl Chloride Pipe (PVC) Pipe and Fittings.**

2.4.1. **Polyvinyl Chloride Pipe, 2 Inch through 20 Inch.** Provide PVC pipe 4 in. and larger with integral bell type gasketed push-on joints or plain end pipe with twin-gasketed couplings conforming to the requirements of ASTM Designation D3139 for push-on-type joints. Use rubber gaskets conforming to the requirements of ASTM Designation D1869. Lubricate gaskets with a nontoxic water-soluble lubricant before joining pipe units. Fit pipe units together in such a manner to avoid twisting or damaging the rubber gasket.

Mark furnished PVC pipe on the spigot end for proper depth of makeup to the bell end of a joining length of pipe or fitting.

Provide valves for use with PVC pipe conforming to the requirements of Section 2.9., “Gate Valves, Tapping Valves, and Tapping Sleeves,” except provide valve ends of the push-on-joint type for use with PVC pipe. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines. Ensure PVC pipe bears the National Sanitation Foundation Seal of Approval (NSF-PW).

Provide PVC meeting the following thickness when using restrained joints:

- DR 18: For restrained joints where shown in the plans.
- DR 14: For alternate to offset pipe sections shown on the plans. Do not use PVC pipe for offset sections with depth cover greater than 20 ft. or less than 4 ft. Do not use PVC pipe in potentially petroleum-contaminated areas.

Make curves and bends by deflecting joints. Do not exceed the maximum deflection recommended the by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Engineer.

Gaskets: Use gaskets meeting the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight. Flat Face Mating Flange: Full faces 1/8 in. thick ethylene propylene rubber (EPR). Raised Face Mating Flange: Flat ring 1/8 in. EPR, with filler gasket between the outside diameter (OD) of the raised face and the flange OD to protect the flange from the bolting moment. Lubricant for rubber-gasketed joints: Water- soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, and causing no deteriorating effect on PVC or rubber gaskets. Use one manufacturer to furnish PVC pipe. When an approved PVC system is used as alternate to offset pipe section, a second manufacturer may be used. Do not use PVC pipe in potentially or known contaminated areas. Do not use PVC pipe in areas exposed to direct sunlight.

Ensure the pipe manufacturer performs hydrostatic testing accordance with AWWA C 900, AWWA C 905, AWWA C 909, and ANSI A 21.10 (AWWA C 110) at the point of manufacture. Obtain from the manufacturer

and submit to the Engineer, the manufacturer's written certification that the pipe and fittings used on this project have passed the hydrostatic test.

2.4.2. **Fittings for Polyvinyl Chloride Pipe, 2 Inch.** Provide PVC pipe manufactured in accordance with the requirements of ASTM Designation D1784 for PVC 12454B (Type I, Grade 1) or PVC 12454C (Type I, Grade 1) and with a standard thermoplastic pipe dimension ratio (SDR) equal to 21.

Use fittings for 2 in. PVC pipe with a minimum pressure rating of 200 psi. Use fittings of the solvent-weld, socket type conforming to the requirements of ASTM D2466, or the gasketed push-on type conforming to the requirements of ASTM D2241. Use PVC solvent cements manufactured in accordance with ASTM D2564.

2.4.3. **Polyvinyl Chloride Pipe, 4 Inch Through 20 Inch.** PVC pipe 4 in. through 12 in.: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20 ft. lengths; cast-iron equivalent outside diameters. Pipe 14 in. through 20 in.: AWWA C 905; Class 235; DR 18; nominal 20 ft. lengths; cast-iron equivalent outside diameter.

Use joints conforming to the same requirements as those specified for 2 in. PVC pipe.

2.4.4. **Bends and Fittings for PVC Pipe, 4 Inch through 20 Inch.** Provide fittings conforming to the requirements of Section 2.3.2., "Fittings for Ductile-Iron Pipe." Use polyethylene wrapped fittings as required by Section 2.13., "Polyethylene Film Wrap," and Section 3.16., "Polyethylene Film Wrap."

Provide restrained joints with enough distance from each side of the bend, tee, plug, or other fitting to resist thrust developed at the design pressure for the pipe.

Approved Certa-Lok PVC restrained joints, 200-250 psi, may be provided for up to 12 in. in diameter. Where preventing movements of 12 in. diameter or greater pipe due to thrusts is necessary, provide the following restrained joints, or approved equal:

2.4.4.1. **Fittings.** JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc. or Series 500 Fitting Restrainer by Ebba Iron, Inc., One Bolt by One Bolt, Inc., or approved equal.

2.4.4.2. **Bell and Spigot.** JCM 620 or 621 Sur-Grip Bell Joint Restrainer by JCM Industries, Inc. or Series 1500 or Series 1100HV Joint Restrainer by Ebba Iron, Inc., One Bolt by One Bolt, Inc., or approved equal.

2.4.5. **Nonmetallic Pipe Detection.** Where nonmetallic pipe is installed longitudinally underground, provide for a method of detecting the location of the nonmetallic pipe. The specific method is shown on the plans or will be approved. This system may involve some components to be installed in the trench around the pipe to be detected using a metal detector. Or the system may consist of locating equipment capable of creating a non-destructive pressure wave which can be detected above ground using a portable detection device with both audible and visual indicators. Ensure either system of detection is capable of accurately locating the pipe to a maximum depth of 3 ft. over the areas shown on the plans.

Either system must be capable of locating lines under earth, concrete, or asphaltic surfaces. Use equipment, materials, and installation as specified by the manufacturer.

2.5. **Fiberglass Reinforced Plastic (FRP) Pipe for Casing.**

2.5.1. **FRP Casing Pipe.** Ensure pipe used for casing is centrifugally cast fiberglass pipe conforming to the requirements of AWWA Standard C 950 and the requirements of this section.

Design fiberglass casing pipe wall thickness to withstand the most critical simultaneous application of external loads, including construction loads and internal pressures. Base the design on the minimum of AASHTO HS-20 loading, AREMA E-80 loads, and depths of bury as indicated on the plans. Design for the most critical groundwater level condition. The pipe design conditions follow:

- Working Pressure = 100 psi

- Hydrostatic Field Test Pressure = 150 psi

Provide the pipe with pressure rated fiberglass sleeve couplings or O-ring bell-and-spigot joints that use elastomeric sealing gaskets to maintain joint water-tightness conforming to the requirements of ASTM D 4161. Provide the casing end treatments with rubber boot type seals capable of maintaining casing water-tightness. Provide casing pipe, gasketing and end treatments that have a very-low to zero corrosive reaction to the chemicals listed on the pipeline product lines shown in the plans. The pipeline products encountered at proposed water line crossings include, but are not limited to:

- MTBE (Methyl Tertiary Butyl Ether)
- TBA (tertiary butyl arsine)
- Nitrogen
- Benzene
- Petroleum
- Natural Gas
- Ethane

Provide pipe manufactured with an epoxy vinyl ester resin with the physical and chemical properties of HETRON 970-35 by Ashland, or approved equal.

Provide fiberglass casing sections in nominal lengths of 20 ft. Provide a stiffness class of fiberglass pipe that satisfies design requirements, but not less than 46 psi, when used in direct bury operation. For tunneled and augered sections, use pipe and pipe joints designed to carry loads including but not limited to: Overburden and lateral earth pressures, subsurface soil, grouting, other conditions of service, thrust of jacks, and stress anticipated during handling and installation. Do not create grout holes with pipe.

Submit shop drawings signed and sealed by a Professional Engineer licensed in State of Texas showing following:

- Manufacturer's pipe design calculations including thrust restraint design.
- Details of pictorial nature of critical features and specials indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and fully dimensioned details, with plan view detailing pipe invert elevations, bends, and other critical features. Indicate station numbers for fittings corresponding to the e plans. Do not start production of pipe and fittings before review and approval by Engineer. Provide final approved lay schedule on CD-ROM in Adobe Portable Document Format (*.PDF).
- Certification from manufacturer that design was performed for the project in accordance with the requirements of this section. This Certification is to be signed and sealed by Professional Engineer licensed in the State of Texas.
- Gasket and resin selection for approval.

2.6. **Joint Bonding and Electrical Insulation.** For electrical bond wires, use a minimum No. 2 AWG, 7 strand, and copper cable, furnished with high molecular weight polyethylene insulation (HMWPE). Remove 1 in. of HMWPE insulation from each end of the bond wire. Provide 2 bond wires as shown on the plans.

Provide a flange adaptor with an insulating kit, as required, when connecting new piping to existing piping and piping of different materials. Provide electrical flange insulation through the installation of the following materials:

2.6.1. **Insulating Gasket.**

2.6.1.1. **Piping Sized 30 Inches in Diameter and Greater.** Provide Pyrox G-10 with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

2.6.1.2. **Piping Sized Between 12 Inches and 24 Inches in Diameter.** Provide Phenolic PSI with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

The Contractor may provide a plain-faced phenolic gasket, as manufactured by Pipeline Seal and Insulator, Inc., or approved equal. Place the phenolic gasket between two full-faced gaskets. Provide cloth-inserted rubber gasket material, 1/8 in. thick in accordance with AWWA C207. Use gaskets that are factory cut to proper dimensions.

2.6.2. **Sleeves and Washers.**

2.6.2.1. **Piping Sized 30 Inches in Diameter and Greater.** Provide full length Mylar sleeves with Pyrox G-10 washers, double washer sets as manufactured by Pipeline Seal and Insulator Inc., or equal.

2.6.2.2. **Piping Sized Between 12 Inches and 24 Inches in Diameter.** Provide full length Mylar sleeves with phenolic washers, double washer sets as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

2.7. **Copper Tubing for Copper Service Lines and Small Mains.** For 3/4 in., 1 in., 1-1/2 in., and 2 in. diameter copper tubing for underground service, use Type “K” soft annealed and seamless with the proper bending temper and conforming to ASTM Designation B88 and Federal Specification WW-T-799 with the following exceptions:

Section 14 of ASTM Designation B88 is hereby modified to provide for the following number of samples for each size of tubing:

- For each 7,500 ft. of tubing 1 sample
- Items of less than 7,500 ft. of tubing 1 sample

Furnish 3/4 in. and 1 in. tubes in 60 ft. coils. Furnish 1-1/2 in. and 2 in. tubes in coils of minimum 40 ft. length. Use minimum joint spacing in multiples of 60 ft. or 40 ft. respectively

Provide flared or compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C800.

2.8. **Brass Fittings for Underground Services Lines and Small Mains (Less Than 24 inch Diameter).**

2.8.1. **General.** Unless otherwise provided in this specification, use brass fittings in underground installations of service lines and small mains in the water distribution system.

Use brass fittings composed of Copper Alloy No. C 83600 conforming to the requirements of ASTM Designation B62. Ensure the general pattern for each fitting conforms to that of standard brass fittings as manufactured by Mueller Company, Hays Manufacturing Company, or an approved equal.

Compression fittings may be used for unions except where they occur under existing or future paving. Use compression tube fittings with Buna-N beveled gaskets.

Ensure each fitting has the manufacturer’s name or trademark and size plainly stamped into or cast on the body. Provide straight pipe adjacent to fittings for at least 10 in.

Provide waterways no smaller in diameter than the nominal size of the stop and accurately finish to a watertight joint; face all nuts and washers to a true fit; and design them such that the joint remains watertight and reasonably easy to operate after repeated use over a number of years. Use external threads conforming to AWWA Standard C800 and, on corporation stops, protect them in shipment by using plastic coatings or an alternate approved method.

2.8.2. **Corporation Stops.** Provide inlet ends of one of the following types: Standard corporation stop threads as specified in Table 1, AWWA C800; iron pipe thread (permissible for use with service saddles only); or Hays 4200- 4202 or approved equal.

Use one of the following types of valve body: Tapered plug type; O-ring seat ball type; or the rubber seat ball type.

Provide outlet ends with a flared-copper connection for use with Type-K soft copper or compression type fitting.

For PVC pipe, provide all brass corporation stops specifically designed for use with PVC pipe.

2.8.3. **Curb Stops.** Provide inlet ends with flared copper connections or compression type fittings.

Use a valve body with a straight through or angled meter stop design equipped with padlock wings and of the O-ring seal straight plug type or the rubber seat ball type.

Provide the outlet with female iron pipe threads or swivel nut meter spud threads, 3/4 in. and 1 in. stops, and with 2-hole flanges for 1-1/2 in. and 2 in. sizes.

2.8.4. **Service Saddles.** Provide service saddle with dual straps and one of the following types: Brass body and straps; ductile-iron body and straps, vinyl coated; ductile-iron body, vinyl coated with stainless steel straps.

Taps for PVC Water Mains: Use dual strap or single, wide band strap saddles which provide full support around the circumference of the pipe and a bearing area with enough width along the axis of the pipe, 2 in. minimum, to ensure that the pipe will not be distorted when the saddle is tightened. Use Romac Series 101N wide band, stainless-steel tapping saddle with AWWA standard thread (Mueller thread), or approved equal.

2.8.5. **Angle Stops.** Provide angle stops in accordance with AWWA C800; ground-key stop type with bronze lock-wing head stop cap; inlet and outlet threads conforming to the application tables of AWWA C800; and inlet side with a flared connection or Mueller 110 compression type, or an approved equal.

2.8.5.1. **Outlet for 3/4 Inch and 1 Inch Size.** Provide meter swivel nut with saddle support.

2.8.5.2. **Outlet for 1-1/2 Inch through 2 Inch Size.** Provide O-ring sealed meter flange, iron pipe threads.

2.8.6. **Fittings.** Provide fittings in accordance with AWWA C800 and as described below:

2.8.6.1. **Castings.** Smooth, free from burrs, scales, blister, sand holes, and defects which would make them unfit for their intended use.

2.8.6.2. **Nuts.** Smooth cast and with symmetrical hexagonal wrench flats.

2.8.6.3. **Flare-joint Fittings.** Smooth cast. Machine seating surfaces for metal-to-metal seal, to proper taper or curve, free from any pits or protrusions.

2.8.6.4. **Thread Fittings.** Use N.P.T. threads and protect male threaded ends in shipment by using plastic coatings or other equally satisfactory means.

2.8.6.5. Compression Tube Fittings. Provide with a Buna-N beveled gasket.

Brass fittings will require the following testing:

- Submerge in water for 10 sec. at 85 psi with stops in both closed and open positions.
- Reject any fittings that show air leakage. The Department may confirm tests locally. An entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

2.9. **Gate Valves, Tapping Valves, and Tapping Sleeves.**

2.9.1. **Gate Valves.** Use gate valves conforming to AWWA Standard C500, C509, C515, and the following supplemental specifications:

Provide direct-bury valves and valves in subsurface vaults that open clockwise. Prove above-ground valves that open counter-clockwise.

If the type of valve is not indicated on the plans, use gate valves as line valves for sizes less than 20 in. If the type of valve is specified, no substitute will be allowed.

Use a valve body of straight-through or angled, meter-stop design equipped with the following:

- O-Ring Seal – straight plug type.
- Rubber Seat – ball type

Provide the outlet end with female, iron-pipe threads or swivel-nut, meter-spud threads on 3/4 in. and 1 in. stops; and with a 2-hole flange on 1-1/2 in. and 2 in. sizes.

Where installing at depths greater than 4 ft., provide gate valves with a non-rising, extension stem with a coupling able to attach securely to the operating nut of the valve. Terminate the upper end of the extension stem in a square wrench nut no deeper than 4 ft. from the finished grade. Support the extension stem with an arm attached to the wall of the manhole or structure that loosely holds the extension stem and allows rotation in the axial direction only.

Provide gate valves in factory mutual type meter installations conforming to the provisions of this specification with outside screw and yoke valves, and carrying the label of Underwriter's Laboratories, Inc.

Provide coatings in accordance with AWWA C550; Indurall 3300 or approved equal, that are non-toxic; do not impart taste to water; function as a physical, chemical, and electrical barrier between base the metal and surroundings; and are a minimum 12 mil thick fusion-bonded epoxy. Before assembling the valve, apply the protective coating to the interior and exterior surfaces of the body.

Provide flange joints when the valve is connected to steel pipe.

Mount valves horizontally if the proper ground clearance cannot be achieved by a normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear that is mounted vertically, for above ground operation.

2.9.1.1. **Gate Valves 1-1/2 Inches in Diameter and Smaller.** Use an operating pressure of 125 psi; bronze mounting; rising-stem; single-wedge; disc type; screwed ends; Crane No. 428, or approved equal.

2.9.1.2. **Gate Valves 2 Inches in Diameter.** Use an iron body; double gate; non-rising stem; 150 lb. test; 2 in. square nut operating clockwise to open.

2.9.1.3. **Gate Valves 4 Inches to 12 Inches in Diameter.** Non-directional; standard-wall resilient-seated in accordance with AWWA C509, parallel seat double disc in accordance with AWWA C500, or reduced-wall resilient-seated gate valves AWWA C515; operating pressure of 200 psi; pressure rating bronze mounting; push-on bell ends with rubber joint rings and nut-operated unless otherwise specified; resilient-seated provided by American Darling AFC-500, US Pipe Metro Seal 200, or approved equal; Reduced-wall resilient seated valves by American Flow Control Series 2500, or approved equal; double disc provided by American Darling 52, Clow F-6102, or approved equal; and comply with following unless otherwise shown on the plans:

2.9.1.3.1. **Design.** Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.

2.9.1.3.2. **Body.** Cast or ductile iron; flange bonnet and stuffing box together with ASTM A307 Grade B bolts. Cast the manufacturer's initials, pressure rating, and year manufactured into the valve body.

2.9.1.3.3. **Bronze.** Ensure that the valve components in the waterway contain at most 15% zinc and at most 2% aluminum.

2.9.1.3.4. **Stems**. ASTM B763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2 in. of 12%; non-rising.

2.9.1.3.5. **O-rings.** For AWWA C509, Sections 2.2.6 and 4.8.2. For AWWA C500, Section 3.12.2. For AWWA C515, Section 4.2.2.5.

2.9.1.3.6. **Stem Seals.** Consist of 3 O-rings, 2 above and 1 below the thrust collar, with an anti-friction washer located above the thrust collar.

2.9.1.3.7. **Stem Nut.** Independent or integrally cast of ASTM B62 bronze.

2.9.1.3.8. **Resilient Wedge.** Molded; synthetic rubber; vulcanized and bonded to cast-iron or ductile-iron wedge tested to meet or exceed ASTM D429 Method B; or attached with 304 stainless steel screws; seat against epoxy-coated surface in the valve body.

2.9.1.3.9. **Bolts.** Furnish in accordance with AWWA C509 Section 2.2.5, AWWA C500 Section 3.4, or AWWA C515 Section 4.4.4 stainless steel; cadmium-plated, or zinc-coated.

2.9.1.4. **Gate Valves 14 Inches and Larger in Diameter.** AWWA C500; parallel seat double disc, or AWWA C515; reduced-wall, resilient-seated gate valves; flanged ends and nut-operated unless otherwise specified. Provide reduced-wall resilient-seated valves with 250 psig pressure rating and manufactured by American Flow Control Series 2500, or approved equal. Provide double disc valves with 150 psig pressure rating and manufactured by American Darling 52, Clow F-6102, or approved equal. Comply with following requirements unless otherwise shown on the plans.

2.9.1.4.1. **Body.** Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast the following into the valve body: manufacturer's initials, pressure rating, and year manufactured. When mounting horizontally, equip valves greater in diameter than 12 in. with rollers, tracks, and scrapers.

2.9.1.4.2. **O-rings.** For AWWA C500, Section 3.12.2. For AWWA C515, Section 4.2.2.5.

2.9.1.4.3. **Stems.** ASTM B 763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2 in. of 12%, non-rising.

2.9.1.4.4. **Stem Nuts.** Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.

2.9.1.4.5. **Stem Seals.** Consist of 3 O-rings, 2 above and 1 below the thrust collar, with an anti-friction washer located above the thrust collar for operating torque.

2.9.1.4.6. **Bolts.** AWWA C500 Section 3.4 or AWWA C515 Section 4.4.4; stainless steel: cadmium-plated, or zinc-coated.

2.9.1.4.7. **Discs.** Cast iron with bronze disc rings securely pinned into machined dovetailed grooves.

2.9.1.4.8. **Wedging Device.** Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Provide other moving surfaces integral to wedging action that are bronze monel or nickel alloy-to-iron.

2.9.1.4.9. **Gear Cases.** Cast iron; furnished on 18 in. and larger valves and of extended type with steel side plates; lubricated; gear case enclosed with oil seal or O-rings at shaft openings.

2.9.1.4.10. **Bronze Mounting.** Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.

2.9.1.4.11. **Stuffing Boxes.** Located on the top of the bonnet and outside the gear case.

Provide a bypass for double-disc gate valves 24 in. and larger.

2.9.1.5. **Gate Valves 14 Inches to 36 Inches in Diameter.** Provide AWWA C515, reduce-wall, resilient-seated gate valves with 250 psi pressure rating. Furnish with spur or bevel gearings.

Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.

Use valve body, bonnet, wedge, and operator nut constructed of ductile-iron.

Fully encapsulate the exterior of the ductile-iron wedge with rubber. Ensure the wedge is symmetrical and seals equally well with flow in either direction.

Bolts: AWWA C515, Section 4.4.4, stainless steel; cadmium-plated or zinc-coated.

Provide high-strength bronze stem and nut.

O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets. Provide stem sealed by 3 O-rings. The top 2 O-rings are to be replaceable with the valve fully open at the full rated working pressure. Provide thrust washers for the thrust collar for easy valve operation.

2.9.2. **Tapping Valves.** Provide double disc or resilient wedge type tapping valves meeting the requirements of gate valves, as listed above, except for the type of joints; inlet flanges meeting AWWA C110, Class 125 or meeting AWWA C110, Class 150 or higher and with a minimum eight-hole flange. Provide outlets with standard mechanical or push-on type joints that fit any standard tapping machine.

Provide a valve seat opening such that a full-size shell cutter for the nominal size tap may pass through the valve without any contact with the valve body.

Provide valve boxes conforming to the requirements of Section 2.11., “Valve Boxes.”

2.9.3. **Tapping Sleeves.** Provide tapping sleeve bodies in accordance with AWWA C110 ductile-iron; or AWWA C111 carbon steel; in 2 sections to be bolted together with high-strength, corrosion-resistant, low-alloy, steel bolts, and with mechanical joint ends.

Provide flanged branch outlets of tapping sleeves; machined recess in accordance AWWA C207 Class D, ANSI 150 lb. drilling. Ensure the gasket is affixed around the recess of the tap opening to preclude rolling or binding during installation.

Provide tapping sleeves with a 3/4 in. NPT test opening for testing before tapping. Provide a 3/4 in. bronze plug for the opening.

2.9.3.1. **Steel Sleeves.** Do not use steel sleeves for taps greater than 75% of the pipe diameter.

Use steel sleeves only on pipe diameters 6 in. and larger. No “size-on-size” sleeve will be permitted (i.e., 6 in. x 6 in., etc.). To accomplish size-on-size connections, the next smaller tap may be made and a LEB (large end bell) increaser used. Where fire service from a 6 in. main is approved, only a ductile-iron split sleeve is permitted.

Provide a body of heavy welded steel construction. Groove the top half of the body to permanently retain a neoprene O-ring seal against the outside diameter of the pipe.

Provide fusion-bonded steel sleeves, epoxy-coated to a minimum 12 mil thickness. Ensure the finished epoxy coat is free of laminations and blisters; does not peel; remains pliant and resistant to impact. Ship steel sleeves in wooden crates that protect the epoxy coating during transport and storage.

Use bolts and nuts conforming to AWWA Standard C500, Section 3.5, and coated with a 100% vinyl resin (or made of corrosion resistant material).

Steel Tapping Sleeves: Use Smith Blair No. 622, Rockwell No. 623, JCM No. 412, or approved equal.

2.9.4. **Air Release and Vacuum Relief Valves.**

2.9.4.1. **Combination Air Valves.** Provide where combination air valves are designed to fulfill the functions of air release, permitting the air accumulated in the line at the high point of elevation to escape while the line is under pressure, and vacuum relief. Valve exterior: Paint with shop-applied primer suitable for contact with potable water. Provide Apco Model 145C or 147C, Val-matic Series 200, or approved equal valves as shown on the plans.

2.9.4.2. **Air Release Valves.** Provide with flanged inlet and outlet connections as specified on the plans. For 2 in. and 3 in. single body valves, size the orifice for a 100 psi working pressure. Fabricate the air relief valve of materials as follows: body and cover, ASTM A 48, Class 30 cast-iron; float and leverage mechanism, ASTM A 240 or A 276 stainless steel; orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt. Other valve internals: stainless steel or bronze.

2.9.4.3. **Air Release and Vacuum Valves.** Provide single-body standard combination or duplex-body custom combination valves as shown on the plans.

2.9.4.3.1. **2 Inch and 3 Inch Single-body Valves.** Provide inlet and outlet sizes as shown on the plans and an orifice sized for a 100 psi working pressure. Valve materials: Body, cover, and baffle, ASTM A48, Class 35, or ASTM A126, Grade B cast iron; plug or poppet, ASTM A276 stainless steel; float, ASTM A240 stainless steel; seat, Buna-N; other valve internals, stainless steel. Paint valve exterior with an epoxy shop-applied primer. Provide Apco Model 145C or 147C, Val-Matic Series 200, or approved equal.

2.9.4.3.2. **3 Inch and Larger Duplex-body Valves.** As shown on the plans, provide an Apco Series 1700 with a No. 200 air release valve, GA Industries Fig. No. AR/GH-21K/280, or approved equal.

Air and vacuum valve materials: Body and cover, ASTM A48, Class 35, cast iron; float, ASTM A240 stainless steel; seat, Type-304, stainless steel and Buna-N; other valve internals, stainless steel or bronze. Air release valve: Construct as specified in Section 2.9.4.2., “Air Release Valves.”

2.9.5. **External Coating Above Ground Valves.** Coat valves with a polyurethane coating conforming to the same requirements under Section 2.2.7.3.2.2, “Polyurethane Coating.”

2.10. **Butterfly Valves.** Provide butterfly valves and operators conforming to the requirements of AWWA Standard C504 Class 150B, except as modified or supplemented in this specification. Provide short-body valves with a flanged design for closing against a flow velocity of 16 ft. per sec. at a normal working pressure of 150 psi and with a downstream pressure of 0 psi (Class 150B).

Provide direct-bury valves and valves in subsurface vaults that open clockwise. Provide above-ground and plant valves that open counter-clockwise.

Body: Cast iron, ASTM 126, Class B.

Discs for Butterfly Valves: Either cast-iron or ductile-iron.

Provide valves with Buna-N or neoprene seats mounted either on the disc or in the body. Mechanically secure the seats, not relying solely on adhesive properties of epoxy or similar bonding agents to attach the seats to the body. Mechanically retain the seats on the disc by using stainless steel (18-8) retaining rings held in place by stainless steel (18-8) cap screws that pass through a rubber seat for added retention. When the seat is on the disc, retain the seat in position by using shoulders located on both the disc and the stainless-steel retaining ring. Provide mating surfaces for seats of Type 304 or Type 316 stainless steel, secured to the disc by mechanical means. Sprayed on or plated mating surfaces will not be allowed. Provide a cast-iron disc conforming to ASTM A126, Class B or ductile-iron conforming to AWWA C151. The seat must be replaceable in the field for valves greater than 30 in. in diameter. Valves with segmented retaining rings will not be accepted.

Coat interior wetted ferrous surfaces of the valve, including the disc, with epoxy suitable for potable water conditions. Furnish epoxy, perform surface preparation, and apply epoxy in accordance with AWWA C550 and the coating manufacturer's recommendations. Provide 3 coats of 2-component, high-build epoxy with a minimum dry thickness of 12 mils. Use Indurall 3300, or approved equal, epoxy coating. Holiday test and measure the coatings for thickness.

Use Type 304 or Type 316 stainless steel for the valve shaft and keys, 24 in. in diameter and greater, that require a minimum of 2 in., or taper pins used for attaching the valve shaft to the valve disc. Do not use a torque plug to attach the valve shaft to the valve disc. All portions of shaft bearings: Stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with a proven record of preventing Teflon flow under load) in accordance with AWWA C504, stainless steel bearing material. Design the valve shaft to withstand 3 times amount of torque necessary to the open the valve.

Packing: Field-adjustable, split-V type, and replaceable without removing the operator assembly.

Retaining hardware for seats: Type 304 or Type 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats: Securely held with lock tight, or other approved method, from loosening by vibration or cavitational effects.

Seat the valve disc in a position 90° to the pipe axis and ensure it rotates 90° between the fully-opened and tightly-closed position. Install valves with valve shafts horizontal and the convex side of the disc facing the anticipated direction of flow, except where shown otherwise on the plans.

Use push-on or flanged (flanged valves coupled to Bell-Flange adapters may be used) joint types for installation with cast-iron or ductile-iron pipe. Use flanges conforming in dimensions and drilling to ANSI B16.1 for cast-iron body valves, Class 125. Use bolts conforming to AWWA Standard C500, Section 9, in valve installations, including bolts for operators, housing, etc. Use flanged joints for steel or concrete steel cylinder pipes.

Provide properly sized gear type actuators for valves 8 in. and larger. Provide fully enclosed and traveling-nut type, rack and pinion type, or worm-gear type gear actuators. Equip direct-bury valves with a 2 in. square nut operating clockwise to open the valve. Completely enclose the space between the actuator housing and the valve body. Ensure that no moving parts are exposed to the soil or elements. Provide oil-tight and water-tight actuators, factory packed with suitable grease. Use operators conforming to the requirements of AWWA Standard C504 and equipped with adjustable limit stop devices.

Design worm-gear and traveling-nut operators so a torque of 150 ft.-lb. or less will operate the valve at the most adverse condition for which the valve is designed. Ensure the vertical axis of the operating nut does not move as the valve is opened or closed.

If the type of valve is not indicated on the plans, use butterfly valves for line valve sizes 24 in. and larger. For valves 24 in. and larger, provide valves manufactured by Pratt, Dezurik, or approved equal. Provide valves from an approved manufacturer. Provide valves and actuators from the same valve or actuator manufacturer. Ensure the shaft connecting the actuator to the valve body is fully enclosed. Provide a fully enclosed, watertight bonnet and extension

2.11. **Valve Boxes.** Provide Type "A," cast-iron or ductile-iron slide-type valve boxes as manufactured by Bass and Hays Foundry, Inc. or approved equal. Ensure the chemical composition of Casting "A" conforms to the requirements of AWWA Standard C110. Fabricate the base of each valve box from 6 in. cast-iron or ductile-iron pipe, conforming to the requirements of this specification except that the lining and coating will comply with this section.

Cast a letter "W" into the lid, 1/2 in. in height and raised 3/32 in., for valves serving potable water lines.

Coat boxes, bases, and lids by dipping them in hot bituminous varnish.

2.12. **Fire Hydrants.**

2.12.1. **General.** Provide fire hydrants, including 6 in. gate valve and box, conforming to the requirements of AWWA C502, except as modified or supplemented in this specification, and that are on the Utility Owner's approved products list.

Provide fire hydrants in conformance with AWWA C 502, Standards for Dry Barrel Fire Hydrants (Latest Edition). Provide hydrants that are approved by the City of Houston. Only hydrants with a current Certification of Responsibility will be allowed. The hydrants shown in Table 4 are currently approved. Alternative hydrants will not be considered.

Table 4
Approved Hydrants

Hydrant	City of Houston Engineering Control Drawing
U.S. Pipe and Foundry Con. M-94 Metropolitan 5-1/4 in. A495	DWG 960324 Rev. dated 2/06/02
Mueller Company Super Construction 250 5-1/4 in. A423	DWG FH-70 Rev. B dated 7/02/08
American AVK Company AVK Series 2780 Nostalgic	DWG 2780-Houston-2Rev. AAD3, dated 3/24/04

Ensure they are of dry-barrel, tamper resistant, and collision-safety construction design. Provide hydrants from same manufacturer throughout the project.

Installation of used, salvaged, or reconditioned fire hydrants will not be permitted.

2.12.2. **Hydrant Barrel.** Fabricate the lower hydrant barrel as a ductile-iron single piece, and connect it to the upper hydrant barrel by means of a joint coupling that will provide a 360° rotation of the upper barrel. Clearly mark the finish grade on the barrel. Provide the specified bury length, equal to the distance from the bottom of the inlet to the ground line.

Provide the hydrant barrel with a non-tapped, non-corrodible drain or drip valve, completely made of bronze or bronze-lined. Ensure the drain valve operates, automatically and positively, to drain the barrel when the hydrant valve is in the fully-closed position, and to completely close the drain opening so as to prevent leaking when the hydrant valve is in the open position.

Equip each hydrant barrel with two 2-1/2 in. nominal inside diameter hose nozzles and a single 4 in. nominal inside diameter pumper nozzle conforming with National (American) Standard Fire Hose Coupling Screw Threads, bronze (minimum Grade D) (per NFPA No. 194 and ANSI B26-1925).

Security fasten field-replaceable nozzles into the upper barrel by mechanical means, install by turning counterclockwise, seal with O-rings, and mechanically lock in place with a security device. Provide nozzles with nozzle caps and neoprene gasket seals. Securely attach the caps to the hydrant barrel with chains of not less than 1/8 in. diameter. Situate the pumper nozzle to allow an unobstructed radius of 10 in. from the threaded surface of the nozzle throughout the path of travel of a wrench or other device used to fasten a hose to the nozzle.

Orient the hydrant so that the pumper nozzle faces the curb or street nearest the hydrant.

Design the barrel joint connecting the upper and lower hydrant sections so that the hydrant shut-off valve will remain closed and reasonably tight against leakage in the event of an impact accident resulting in damage to or breaking of the hydrant above or near ground level. Provide the joint with a breakable bolt flange or breakable coupling including an adequate number of bolts, above finish grade.

Fabricate the operating and hold down nuts of stainless steel, cast-iron, or ductile-iron with bronze inserts. Provide a security device with each hydrant employing a bronze operating nut to protect this feature of the hydrant from malicious mischief or unauthorized removal. Ensure that such security devices do not require special tools for normal off/on operation of the hydrant. For the operating nut, use a tapered pentagon 1-1/2 in. point to face at the base, and 1-1/8 in. point to face at the top of the nut, opening left (counter-clockwise). Fabricate hold down assemblies of metallic materials suitable for the intended service.

Design the hydrant barrel to permit the use of one or more standard extensions, available from the hydrant manufacturer, in lengths from 6 in. to 60 in. in 6 in. increments.

2.12.3. **Shut-off Valve and Inlet Shoe.** Provide hydrants with circular, compression-type shut-off valves which close with the water pressure, with center stem construction and which remain closed and tight against leakage upon impact. Ensure each shut-off valve is circular and not less than 5-1/4 in. in diameter. Seal the bottom end of the stem threads from contact with water by using a cap nut. Provide a bronze valve seat ring, threaded into a bronze drain ring to provide an all-bronze drain way. Ensure the seat ring and main valve assembly is removable from above ground through the upper barrel by using a light-weight seat removal wrench.

Construct the valve seat facing of molded rubber with a Durometer rating of 90 ± 5, a minimum thickness of 1/2 in., and that is resistant to microbiological attack.

Unless otherwise shown on the plans, provide a hydrant inlet shoe that is an elbow with the AWWA standard bell designed for a nominal 6 in. mechanical joint hub end, or push-on assembly as specified. Provide a hydrant shoe of cast-iron or ductile-iron pipe that is flanged, swivel or slip joint with harnessing lugs for restrained joints. Coat the interior of the shoe with a minimum of 12 mils of fusion bonded epoxy conforming to NSF Standard 61. For underground flanging, incorporate a minimum of six 3/4 in. diameter electro-galvanized or cadmium-coated steel bolts or four 5/8 in. diameter stainless or cadmium-coated steel bolts.

2.12.4. **Valve Stem.** Where threads are located in the barrel or waterway, use Everdure operating stems, or other high-quality, non-correctible metal.

Use bronze-to-bronze working parts in the waterway; genuine wrought-iron or steel where threads are not located in the barrel or waterway, bronze bushed at the penetration of the stuffing box; seal the threads against contact with water regardless of the (open or closed) position of the main valve. Provide the valve stem with a breakable stem coupling opposite the barrel breakaway feature. Construct connecting pins and locking devices of bronze or other corrosion-resistant material. Provide the valve stem with a bronze sleeve, O-ring seals, and travel stop. Ensure the operating threads, working parts, and bearing surfaces are fully lubricated during normal operation of the fire hydrant. Ensure the lubricant is contained in a lubricating reservoir that is sealed at the top and bottom. Equip the operating assembly with a thrust bearing or lubricated thrust collar to minimize operating torque. Provide a lubricant meeting the requirements of FDA 21 CFR 178.3570 and manufactured with FDA-approved oxidation inhibitors.

Provide a valve stem that operates counterclockwise (turning to the left) to open.

2.12.5. **Gaskets and Seals.** Provide dynamic seals of O-ring type, oil-resistant material, which do not require adjustment for a watertight seal. Provide moving parts in contact with the seal made of bronze or other corrosion-resistant material.

Provide static seals of Buna “N” or other approved synthetic composition.

2.12.6. **Painting.** Shop coat the fire hydrant's exterior with 1 coat of rust prohibitive primer. Ensure the top half of the hydrant from the traffic flange up, receives 1 coat of blue enamel before delivery to the jobsite as outlined by the following:

2.12.6.1. **Exterior Above the Traffic Flange (Including Bolts and Nuts).** Prepare the surface in accordance with SSPC-SP10 (NACE 2), near-white blast-cleaned surface.

Coat with a 3-coat alkyd/silicone/alkyd system with a total dry film thickness (DFT) of 6-9 mils as follows:

- Prime Coat. Oil Modified Alkyd Primer, Acro Products No. 1104, Heavy Duty Tank & Steel Primer, or approved equal, in general accordance with SSPC Paint Specification No. 25. Apply with a total dry film thickness (DFT) of 2-3 mils.
- Intermediate Coat. Heavy Duty Heavy Duty Industrial Alkyd Enamel, Acro Products No. 2214, or approved equal, in general accordance with SSPC Paint Specification No. 104, and Federal Standard TT-E-489. Apply with a total dry film thickness (DFT) of 2-3 mils.
- Finish Coat. Silicone Alkyd Resin Enamel, Acro Products No. 2215, or approved equal, in general accordance with SSPC Paint Specification No. 21. Total dry film thickness (DFT) of 2-3 mils. Except do not finish shop coat the hydrant bonnet, only intermediate coat it. Field applies and color code the finish coating when installed.
- Colors. For primer, use the manufacturer's standard color. For the finish coat of the hydrant body, use blue (Acro 555 crystal blue or equivalent). Finish coat the hose connection caps white, and paint a white band of finish coat 2 in. in width on the hydrant body approximately 6 in. above and parallel to the traffic flange. For intermediate coat, use a contrasting color to the blue finish coat, such as white.

2.12.6.2. **Exterior Below the Traffic Flange.** Prepare the surface in accordance with SSPC-SP10 (NACE 2), near-white blast-cleaned surface.

Coat with a 3-coat system as follows:

- Primer and intermediate coat - coal tar epoxy, Acro Products No. 4467, or approved equal, in general accordance with SSPC Paint Specification No. 16. Apply 2 coats with a dry film thickness (DFT) of 8-10 mils each, for a total dry film thickness (DFT) of 16-20 mils.
- Finish coat - water based vinyl acrylic mastic, Acro Products No. 7782, or approved equal. Apply 1 coat with a dry film thickness (DFT) of 6-8 mils. For the color of the finish coat, use the same as for the finish coat for the exterior above the traffic flange i.e., blue (Acro 555 crystal blue or equivalent).

2.12.6.3. **Interior Surfaces Above and Below the Main Valve.** Provide material used for internal coating of hydrant interior ferrous surfaces below the main valve that is NSF61 listed as suitable for contact with potable water, as required by Chapter 290, "Rules and Regulation for Public Water Systems," Texas Commission on Environmental Quality (TCEQ).

Prepare the surface in accordance with SSPC-SP10 (NACE 2), near-white blast-cleaned surface.

Provide a liquid or powder epoxy system coating in accordance with AWWA Standard C-550. Apply the coating in 2 or 3 coats, according to the manufacturer's recommendations, for a total dry film thickness of 12-18 mils.

2.12.6.4. **General.** Apply coatings in strict conformance with the manufacturer's recommendation. No requirement of this specification cancels or supersedes the written directions and recommendations of the specific coating manufacturer so as to jeopardize the integrity of the applied system.

Ensure the hydrant supplier furnishes an affidavit of compliance that the materials and work furnished comply with the requirements of this specification and referenced applicable standards.

After installing the hydrants and before the main is accepted, paint the bonnet portion of each fire hydrant as shown in Table 5.

Table 5
Fire Hydrant Bonnet Colors

Size of Supply Line (in.)	Color of Bonnet
6	Yellow
8	White
10-20	Green
24 and Larger	Orange

Ensure the color shades and paint quantities are approved and comply with the current specifications.

2.12.7. **Performance Standards.** Provide hydrants capable of a free discharge of 1,500 gal. per minute (gpm) or greater, from a single pumper nozzle at a hydrant inlet static pressure not exceeding 20 psig as measured at or corrected to the hydrant inlet at its centerline elevation.

Provide hydrants capable of a discharge of 1,500 gpm or greater from a single pumper nozzle at a maximum permissible head loss of 8.0 psig (when corrected for inlet and outlet velocity head) for an inlet operating pressure not exceeding 37 psig as measured at or corrected to the hydrant inlet at its centerline elevation.

2.12.7.1. **Hydraulic Performance Testing.** AWWA C502; ensure the certified pressure loss and quantity of flow test is conducted by a qualified testing laboratory on a production model (5-ft. bury length) of the hydrant (same catalog number) proposed for certification. Submit a certified test report containing following information:

Date of test, within the previous 5 yr., on a fire hydrant with similar hydraulic characteristics.

Name, catalog number, place of manufacture, and date of production of hydrants tested.

Schematic drawing of testing apparatus, containing dimensions of piping elements including:

- Diameter and length of inlet piping.
- Distance from flow measuring points to pressure measurement point.
- Distance from flow and pressure monitoring points to the hydrant inlet.
- Distance from pressure monitoring point to nozzles.
- Diameter and length of discharge tubing.

Elevation of points of measurement, inlet, and outlet.

Reports or certificates documenting the accuracy of the measuring devices used in testing.

Conduct the tests on at least 3 hydrants of the same fabrication design. Inlet water temperature: 70°F ± 5°F.

For traffic impact testing, submit a certified test report outlining the results of the traffic impact test involving standard production models of the fire hydrant with breakable barrels of the same design as that proposed for certification. Install these hydrants per AWWA C600; strike at a point 18 in. ± 2 in. above the designated ground line. Conduct tests using the point of impact on hydrant barrel within 2 in. of a line perpendicular to base and equidistant from the pumper nozzle and one hose nozzle.

Conduct successive tests simulating impacts by standard American-made vehicles with gross weights of 3,500 lb., 5,500 lb., and 10,500 lb.

Document the tests to provide the following minimum information:

- Detailed schematic drawings of the test facility.
- Complete description of the mechanical impact testing equipment used.
- Complete list of the hydrant parts and materials damaged in each impact test.
- Photographs.

- Size and static pressure of the line to which the hydrant is attached.
- Estimated of amount of water discharged, if any, from the hydrant within 30 min. immediately following the collision.

2.12.8. **Hydrant Leads.** Provide hydrant branch leads conforming to the same requirements under Section 2.2.3., "Steel Pipe Fittings;" Section 2.3., "Ductile-Iron Pipe and Fittings;" or Section 2.4., "Polyvinyl Chloride Pipe (PVC) Pipe and Fittings."

2.13. **Polyethylene Film Wrap.**

2.13.1. **General.** Except where noted on the plans, use polyethylene film as a wrap to protect cast-iron pipe, ductile-iron pipe, and fittings. Provide polyethylene film conforming to the requirements outlined in this specification and use only in open-cut construction.

2.13.2. **Film.** Provide polyethylene film in accordance with ASTM 1248 and AWWA C105, Type 1, Class C, Category 5, Grade J-3, 2.5% to 3% carbon black content. Unless otherwise shown on the plans, provide film 8 mils thick with a minimum tensile strength of 1,200 to 2,500 psi, elongation up to 600% and either in tubular or sheet form. Furnish film supplied in tubular form in the minimum widths shown in Table 6.

Table 6
Minimum Width of Film Tube (when laying flat)

Nominal Pipe Size (in.)	Push-on Joint Flat Tube Width (in.)
4	14
6	17
8	21
10	25
12	29
14	33
16	37
18	41
20	45
24	53

For film in sheet form, furnish in widths equal to twice that shown for tube widths.

2.13.3. **Polyethylene Tape.** For taping film edges and overlays, use 3 in. wide plastic-backed adhesive tape. Use Polyken No. 900, Scotch Wrap No. 50, or approved equal.

2.14. **Bedding Material.** Unless otherwise shown on the plans, provide one of the following types of bedding for water mains:

2.14.1. **Bank Run Sand.** Furnish bank run sand bedding as called for in these specifications and consisting of soil classified as SP, SW, or SM by the Unified Soil Classification System (USCS). Provide sand with a plasticity index, when tested, of less than 7% and a liquid limit of 25 or less. Ensure the bank run sand gradation has a maximum of 15% passing the No. 200 sieve when tested, and is free of roots, organic material, trash, clay lumps, or other deleterious or objectionable material.

2.14.2. **Concrete Sand.** Furnish concrete sand bedding conforming to the specifications for Fine Aggregates specified in ASTM Standard C-33. Provide Fine Aggregates consisting of natural sand, manufactured sand, or a combination of the two, within the gradation limits shown in Table 7.

Table 7
Fine Aggregate Gradation

Sieve Size	Percent Passing
3/8 in.	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps, or other deleterious or other objectionable materials, in excess of the limits prescribed in the C-33 Standard.

2.14.3. **Pea Gravel.** Furnish pea gravel bedding conforming to the specifications for Coarse Aggregates specified for No. 8 size in ASTM Standard C-33. Provide Coarse Aggregates consisting of gravel composed of small, smooth, rounded, stones or pebbles, within the gradation limits shown in Table 8.

Table 8
Coarse Aggregate Gradation

Sieve Size	Percent Passing
1/2 in.	100
3/8 in.	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps or other deleterious or other objectionable materials, in excess of the limits prescribed in the C-33 Standard.

2.14.4. **Gem Sand.** Furnish gem sand generally conforming to specifications for Coarse Aggregates specified for No. 8 size in ASTM Standard C-33. Specifically, provide aggregates within the gradation limits shown in Table 9.

Table 9
Gem Sand Gradation

Sieve Size	Percent Passing
3/8 in.	95-100
1/4 in.	60-80
No. 4	15-40
No. 10	0-5

Ensure the aggregates do not contain any roots, organic material, trash, clay lumps, or other deleterious or other objectionable materials, in excess of the limits prescribed in the C-33 Standard.

2.15. **Backfill Material.** For sand backfill encasement of water mains, use one of the following materials, unless otherwise shown on the plans:

2.15.1. **Cement Stabilized Sand.** Furnish cement stabilized backfill containing a minimum of 5% cement per cu. yd. of material placed, based on the dry weight of the aggregate in accordance with Tex-120-E. Provide materials consisting of aggregate, cement, and water. Use cement and water conforming to the material requirements of Item 421. Provide sand aggregate, free from deleterious matter, with a plasticity index not greater than 6 when tested by Tex-106-E.

2.15.2. **Earth or Native Soil.** Furnish earth or native soil backfill consisting of soil containing no deleterious material such as trash, wood fragments, organic, or other objectionable material. Supply the material from either the material removed from the excavation or from offsite sources.

The material may consist of soil classified by the Unified Soil Classification System (USCS) as ML, CH, CL, CL-ML, SC, SP, SM, SW, or GC. Use earth backfill that meets the compaction requirements specified in this specification and does not cause any settlement.

2.15.3. **Bank Run Sand.** Furnish bank run sand backfill as called for in these specifications and conforming to the same requirements as those under Section 2.14.1., "Bank Run Sand."

2.16. **Concrete.** Use Class "A" concrete in conformance to the requirements of Item 421, unless otherwise shown on the plans. Leave the forms in place unless directed to remove certain sections of the forms.

2.17. **Water Meters, Meter Vaults, and Meter Boxes.**

2.17.1. **Water Meters.** Provide meters of the type and size indicated on the plans.

2.17.1.1. **Provide Bolted Split Casings.** Main casings of meters and external fasteners: Copper alloy with minimum 75% copper for 5/8 in. to 2 in., bronze or cast-iron, hot-dipped galvanized or epoxy coating for coating for 3 in. and larger.

2.17.1.2. **Straightening Vanes**. Use non-corrosive material compatible with the case material.

2.17.1.3. **Intermediate Gear Train.** Do not allow the intermediate gear train to come in contact with water; operate in suitable lubricant.

Register: Automatic Meter Reading (AMR) type that provides pulse, contact closure, piezo switch, or encoder-generated output signal, compatible with Utility Owner's radio and telephone AMR systems. Provide a minimum 12 ft. of wire when permanently connected to the register. Lens: impact resistant. Register box: tamper resistant by means of a tamper screw or plug: Register: permanently sealed, straight-reading, center-sweep test hand, magnetic driven, reading in U.S. gal. Digits: 6, black in color with the lowest registering three digits (below 1,000 gal. registration) in contrasting digit and background colors. Register capacity of meters: 9.99 million gal. for 5/8 in. to 2 in. and 999.999 million gal. for 3 in. and larger.

Connections: 5/8 in. to 1 in.: threads at each end; 1-1/2 in. to 2 in.: two-bolt oval flanges each end; 3 in. and larger: flange at each end.

Stamp the manufacturer's meter serial number on the outer case. Stamp the manufacturer's meter serial number on the outside of the register lid, when provided. Ensure the manufacturer's serial numbers are individual and not duplicated.

Meters: Equip with AMR type register to connect to the Utility Owner's AMR system. Compound Meter manufactured by: Badger, Hersey Products, Neptune, Sensus, or approved equal. Turbine Meters: manufactured by Badger, Hersey Products, Neptune, Sensus, or approved equal.

Fire Service Meters: manufactured by Hersey Products, Neptune, Sensus, or approved equal. Displacement Meters: manufactured by Badger, Neptune, Hershey, Kent, Sensus, or approved equal.

2.17.1.4. **Manufacturing Quality Control.** Permit successful interchangeability from one meter to another of same size; registers, measuring chambers and units, discs or pistons as units, change gears, bolts, nuts, and washers, without affecting the accuracy of the new meters.

2.17.1.5. **Commercial Meter Valves for Meter Installations.** Provide commercial meter valves identical to line valves except provide them with Class 125 flanges and equip them with hand wheels operating counterclockwise to open.

For pipe and fittings inside the meter box or meter vault, use ductile-iron conforming to Section 2.3., "Ductile-Iron Pipe and Fittings," and as specified on the plans.

2.17.2. **Meter Vaults.**

2.17.2.1. **General.** Furnish meter vaults in either of the following designs: precast concrete vault, cast-in-place concrete vault, or solid masonry, unless a specific type of construction is required on plans. Ensure

dimensions and reinforcement complies with the Utility Owner's standard meter vault drawings for the type and size shown on the plans. Use Class "S" concrete conforming to the requirements of Item 421.

2.17.2.2. **Precast Concrete Vaults.** Construct precast concrete vaults as shown on the plans. Use reinforcing steel conforming to the requirements of Item 440.

Install precast vaults in conformance with the manufacturer recommendations. Set level and on a minimum 3 in. thick bed of sand conforming to the requirements of Section 2.15, "Backfill Material." Seal lifting holes with cement mortar or non-shrink grout.

2.17.2.3. **Meter Vault Floor Slab.** Slope the floor 1/4 in. per foot toward the sump. Make the sump 12 in. in diameter, or 12 in. square, and 4 in. deep, unless other dimensions are shown on the plans. Install dowels at a maximum of 18 in., center-to-center, or install a mortar trench for keying the walls to the floor slab.

2.17.2.4. **Cast-In-Place Concrete Vaults.** Construct cast-in-place concrete vaults as shown on the plans. Use reinforcing steel conforming to the requirements of Item 440. Key the walls to the floor slab.

2.17.2.5. **Frame and Cover.** Use A-36 welded steel, or approved equal. Fabricate the cover plate with a 1/4 in. skid-resistant raised pattern floor plate. Fabricate the meter access door from the same material as the cover plate. Perform welding in accordance with the provisions of Item 441. Nondestructive testing will not be required.

Furnish castings for frames, grates, rings, and covers conforming to ASTM A48 Class 30. Provide locking covers if indicated on the plans. Use castings capable of withstanding the application of an AASHTO HS-20 loading, unless otherwise specified.

Provide covers and frames conforming to the shape dimensions, and with the wording or logos shown on the plans. The standard diameter dimension for manhole covers is 32 in. Furnish frames, grates, rings, and covers conforming to Item 471, except as noted above and except for measurement and payment..

2.17.3. **Meter Boxes.**

2.17.3.1. **General.** Furnish meter boxes for 5/8 in. through 1 in. meters of the following materials:

- Non-traffic bearing locations: cast-iron, concrete, or plastic as specified on the plans.
- Traffic bearing locations: cast iron.

Meter boxes for 1-1/2 in. and 2 in. meters: cast-iron. Provide meter box lids with a key-operated, spring type, locking device and a reading lid. Ensure the lids contain enough metals so that the meter box is easily located with metal a detector. If words are specified on the plans, cast them into lid with letters of 1/2 in. height and raised by 3/32 in. Ensure the size reads 5/8 in. to 1 in. or 1-1/2 in. to 2 in.

Furnish meter boxes conforming to the following approximate dimensions:

- Length: At the top, 15-1/2 in.; at the bottom, 20 in.
- Width: At the top, 12-1/2 in.; at the bottom, 14-3/4 in.
- Height: 12 in.

Ensure that meter box extensions 3 in. and 6 in. in height are available from the manufacturer.

2.17.3.2. **Cast-Iron Meter Boxes**. Furnish cast-iron boxes that are clean and free from sand blow-holes or other defects, and conforming to the requirements of ASTM A48. Machine the bearing surfaces so that the covers seat evenly in the frames. Provide boxes and lids with a dipped, coal-tar-pitch, varnish finish. Provide lock-type meter boxes when shown on the plans. Ensure the lock mechanisms work with ease.

2.17.3.3. **Concrete Meter Boxes.** Furnish concrete meter boxes made of Class "A" concrete conforming to requirements of Item 421. Construct boxes as shown on the plans. Furnish castings that are free from

fractures, large or deep cracks, blisters or surface roughness, or any other defects that may affect serviceability.

2.17.3.4. **Plastic Meter Boxes.** Furnish plastic meter boxes made of high-density polyethylene conforming to the ASTM Specifications shown in Table 10.

Table 10
ASTM Test Requirements for Plastic Meter Boxes

ASTM Test	Requirement
D256	Impact Strength = 1.9 ft.-lb./in. (Izod, Notched)
D256	Impact Strength = 6.4 ft.-lb./in. (Izod, Un-Notched)
D638	Tensile Strength (2.0 Min) = 3,400 psi
D648	Deflection Temperature = 170°F
D790	Flexural Modulus = 90,000 psi
D676	Shore D Hardness, 55-65 Impact
	Strength, Falling Dart Method, 100 in.-lb.

Provide meter boxes meeting the following test requirements:

- Static Load: Not less than 2,500 lb. using a 6 in. disc with direct compression exerted at the center of the top of the meter box with a solid plastic lid.
- Deflection: Not less than 1,000 lb. load required to deflect the top edge of the meter ox 1/8 in.

Provide a meter box body, without lid, weighing approximately 7 lb.

2.18. **Affidavit of Compliance.** Unless otherwise directed, furnish a manufacturer's affidavit of compliance for each of the materials used in this project. Ensure the affidavit certifies that factory inspection and specified tests were performed and that the material furnished complies with the requirements outlined in this specification.

2.19. **Pressure Reducing Station.** Unless otherwise shown on the plans, furnish new and unused station piping, valves, and fittings, of the same type as specified on the plans.

Use Class “S” concrete in conformance with Item 421.

Provide reinforcing steel in conformance with Item 440.

Provide a Pressure Reducing Valve (PRV) with a strainer, in the location and arrangement shown on the plans. Provide a valve body made of ductile iron with Class 150 ANSI B16.1 flanges. Provide a valve cover made of ASTM A 48 cast iron. Use Buna-N rubber parts. No leather parts are allowed. Provide a resilient seat with a rectangular cross-section.

Valve internals: Provide a single moving disc and diaphragm assembly. Use a flexible nylon fabric-reinforced elastomer diaphragm integral with assembly. Provide valve internal trim (seat ring, disc guide, and cover bearing) made of stainless steel. Apply a heat fusion bonded epoxy coating to the internal and external surfaces of the valve body including the disc retainer and diaphragm washer. Holiday test the coating applied to the valve body to confirm a minimum even coating of 5-7 mils. Treat the stem with a penetrative salt nitride process. Use a Xylan-coated seat. Leather parts are not allowed. Prepare threaded connections by first using an approved pipe tape.

Furnish control tubing containing shutoff cocks with a “Y” strainer. Equip the valve to allow installing control tubing on either side of the valve. Equip the valve with a valve position indicator.

Ensure the valve and valve box are initially set in the field by an authorized manufacturer's representative. Set the downstream pressure at 60 psi unless otherwise specified. Ensure the PRV includes an adjustable and pressure sustaining pilot system. Use a diaphragm type or piston type valve for the main valve.

Provide Cla-Val Model 90-01BDSYKCKD, Watts ACV Model 115-3M, or approved equal.

Provide a basket strainer upstream of the pressure reducing valve as shown on the plans. Furnish a quick-opening type strainer body, of fabricated steel construction with ANSI Class 150 flanges. Use Type 304 stainless steel for the basket.

Provide a Hayward Model 90, or equal, for PRV's 4 in. to 24 in. When there are space constraints, provide a Hayward Model 510, or equal, for PRV's 14 in. or greater.

2.20. **Adjusting Manholes.** Reuse removed manhole and inlet rings, plates, grates, covers, and brick if they are in good condition as determined by the Engineer. Provide additional materials in accordance with Item 465 at no cost to the Department. Single- or multiple-piece prefabricated metal extension rings may be used for the adjustment of manholes as approved. Provide concrete that conforms to the requirements of Item 421.

3. CONSTRUCTION

All construction must conform to the requirements of this Item, the plans and the following Items:

- Item 100, “Preparing Right of Way”
- Item 400, “Excavation and Backfill for Structures”
- Item 402, “Trench Excavation Protection”
- Item 403, “Temporary Special Shoring”
- Item 421, “Hydraulic Cement Concrete”
- Item 465, “Junction Boxes, Manholes, and Inlets”
- Item 476, “Jacking, Boring, or Tunneling Pipe or Box”
- Item 479, “Adjusting Manholes and Inlets”

3.1. **Excavation.**

3.1.1. **Trenches.** Construct water lines and fire hydrant branches (leads) in open cut trenches with vertical sides except in those locations where the pipe is tunneled, cased, or augered. Construct the trenches to the dimensions shown in the excavation and backfill details.

Sheath and brace the trenches to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period. Protect excavation greater than 5 ft. in depth as specified by Item 402, or Item 403.

Open and excavate the trenches to the finished grade. To allow for possible adjustment of the alignment and grade, locate the water mains to which the mains and fire hydrant branches (leads) under construction are to be connected, well in advance of making connections.

Construct water mains and fire hydrant branches (leads) in dry trenches. If necessary, employ well pointing or additional sheathing to accomplish this objective, at no additional cost to the Department.

For pipes less than 18 in. in diameter, the minimum trench width below the top of the pipe is the outside diameter of the pipe, plus 18 in. For pipes 18 in. and larger, the minimum trench width below the top of pipe is the outside diameter of pipe plus 24 in. Additional width will be required for unstable conditions. The Engineer will determine unstable conditions.

Where it is necessary to excavate trenches adjacent to improved property, take precautions to avoid damaging or impairing that property. Where it is necessary to disturb grass, shrubs, driveways, etc., restore such improvements to their original condition.

Use enough trench width or benches above the embedment zone when installing well point headers or manifolds and pumps, where the trench depth makes it uneconomical or impractical to pump from the surface elevation. Provide enough space between the shoring cross braces to permit equipment operations and handling the forms, pipe, embedment and backfill, and other materials.

Before moving the supports, place and compact the embedment to enough depth to provide protection of the pipe and stability of the trench walls. As the supports are moved, finish placing and compacted the embedment.

Immediately before placing the embedment materials, ensure the bottoms and sidewalls of trenches are free of loose, sloughing, caving, or otherwise unsuitable soil.

Place and compact the embedment materials directly against the undisturbed soils in the trench sidewalls or against sheeting which will remain in place.

Do not place trench shields or shoring within the height of the embedment zone unless using some means to maintain the density of the compacted embedment material. If using moveable supports in embedment zone, lift the supports incrementally to allow placing and compacting of the material against undisturbed soil.

Place haunching material around the pipe and compact it to provide uniform bearing and side support.

Place trench dams in Class I embedments near the midpoint of line segments longer than 100 ft. between manholes.

Where damage to the completed pipe installation work is likely to result from withdrawal of the sheeting, leave the sheeting in place.

3.1.2. **Existing Streets.** Unless otherwise shown on the plans, open cut existing streets.

Where water line construction requires cutting through existing streets outside the limits of new street construction, replace those streets in kind in conformance with the appropriate specifications in the proposal or as directed. When cutting pavement outside the Department's right of way, comply with the Utility Owner Street Cutting Ordinance.

Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, construct temporary bridges as necessary to facilitate the movement of traffic.

At locations where the proposed water main parallels the edge of an existing permanent pavement (i.e., concrete pavement, concrete base with asphalt surface, etc.), and is 3 ft. or less from the edge of that pavement, protect the trench with timber sheathing and bracing. Leave the bracing in place at intervals of 5 ft. maximum.

Keep the street surface adjacent to the trench free of surplus spoil. Place construction materials at locations that minimize interference with the traveling public.

Do not close more than 2 street intersections at any one time unless authorized in writing..

3.2. **Jacking, Tunneling, Boring, or Augering.**

3.2.1. **General.** Perform jacking, tunneling, or augering for water mains and fire hydrant branches (leads) at the locations shown on the plans and at other locations specifically designated by the Engineer.

Unless otherwise shown on the plans, use casing pipe conforming to the requirements of Section 2.2.2., "Steel Casing Pipe."

Excavate auger pits to a finished grade at least 6 in. lower than that indicated by the construction stakes or as approved, to ensure that a dry pit bottom is encountered.

Provide a minimum width of jacking, tunneling, or augering pits such that there is at least 6 in. of space between the pipe and the walls of the auger pit. The maximum allowable width of the pit is 5 ft., unless otherwise approved. Ensure the width of the pit at the surface is not less than at the bottom. The maximum

allowable length of the pit is 5 ft. longer than 1 full joint of pipe of the type being used and does not exceed 25 ft., unless approved.

Grout in place tunnels for water lines with 36 in. diameters. When casing size is 48 in. in diameter or greater, or when using a tunnel liner plate, regardless of the water line diameter, grout in place unless otherwise directed. Provide an annular grout consisting of a sand-cement mortar mix with a 28 day compressive strength of at least 1,500 psi, when tested in accordance with ASTM C 942. The maximum allowable density is 130 pcf.

Use admixtures meeting ASTM C 494 and ASTM C 1017 as required, to improve pump ability, control the time of set, hold sand in suspension, and reduce segregation and bleeding. Fill the annular space in 3 lifts to prevent pipe floating. In addition, place appropriate blocking between the carrier pipe and the top of the liner to maintain position. Place a concrete invert to facilitate threading the carrier pipe.

Do not allow inadvertent metallic contact between the casing and the carrier pipe. Place spacers to ensure that the carrier pipe is adequately supported throughout its length, particularly at ends, to offset setting and possible electrical shorting, unless otherwise approved by Engineer. Ensure the end spacer is within 6 in. of the end of the casing pipe, regardless of the size of the casing and carrier pipe or the type of spacer used. Casing spacers are designed to withstand much greater loads than can be safely applied to most coatings. Therefore, the spacing between spacers depends largely on the load bearing capabilities of the pipe coating and the flexibility of the pipe.

Install casing spacers in conformance with the manufacturer's instructions. Use special care to ensure that subcomponents are correctly assembled, evenly tightened, and that no damage occurs while tightening the insulators or inserting the carrier pipe.

Seal the annulus between the carrier pipe and casing with casing end seals at each end of the casing.

Insular Spacing:

- Provide spacing as shown on the plans with a maximum distance between spacers of 10 ft. for pipe sizes for pipe sizes 4 in. to 14 in. and 8 ft. for pipe sizes 16 in. to 30 in.
- For ductile-iron pipe, flanged pipe, or bell-and-spigot pipe, install spacers within 1 ft. on each side of the bell or flange, and one in the center of the joint when 18 ft. to 20 ft. long joints are used.
- If the casing or carrier pipe is angled or bent, reduce the spacing. Provide the casing with a smooth, continuous interior surface.

Perform bedding and backfilling of jacking, tunneling, boring, or augering pits in conformance with the details on the plans and these specifications.

3.2.2. **Jacking Steel Casing.** Perform jacking of steel casing in accordance with the requirements of Item 476.

3.2.3. **Tunneling.** Perform tunneling in accordance with the tunneling requirements of Item 476.

3.2.4. **Boring or Augering.** Perform boring or augering in accordance with the requirements of Item 476.

Do not exceed 100 ft. for the length of the auger hole without a receiving pit.

Do not exceed 75 ft. for the length of the auger hole for PVC pipe 12 in. and less in diameter without a receiving pit.

Do not exceed 40 ft. for the length of the auger hole for PVC pipe 16 in. and greater in diameter without a receiving pit.

At locations where water pipes cross underneath driveways (of 16 ft. or less in width) or sidewalks, install the pipe in tight fitting augered holes.

At locations where the centerline of the proposed water main is 10 ft. or less from the centerline of an 8 in. diameter or larger growing tree, place the pipe in a tight fitting augered hole. Extend the bored hole at least 4 ft. beyond each side of the tree.

Block the void space around the pipe in the augered hole with approximately 12 in. of packed clay or similar approved material, so that the bedding or backfill does not escape into the void around the pipe in the auger hole, when compacted.

Around the pipe, a use the minimum volume of the clay or similar acceptable material as shown in Table 11.

Table 11
Volume of Clay or Acceptable Material for Blocking Voids

Pipe Diameter (in.)	Minimum Quantity (cu. Ft.)
4 through 8	0.5
12 through 16	0.75

3.2.5. **Bedding for Trenches and for Jacking, Tunneling, Boring, or Augering Pits.**

3.2.5.1. **Pipe Bedding for Water Mains Less Than 24 Inches in Diameter.**

3.2.5.1.1. **Open Cut Trench Installation.** Construct trenches with a minimum of 6 in. bedding. Remove the soil in the bottom of the trench, excavate to a minimum depth of 6 in. below the bottom of the pipe, and replace the soil with bedding material. Remove saturated material from the bottom of the pit before placing the bedding. Place the pipe in the bedding such that there is a 6 in. bedding below and up to the spring line of the pipe.

Compact the bedding material to within 95% of the standard density within 5% of the optimum moisture as determined by Tex-113-E. Mechanically compact the bedding material by using vibratory equipment or any other acceptable equipment.

3.2.5.1.2. **Jacking, Tunneling, Boring or Augering Pits.** Construct pits with a minimum of 6 in. bedding. Remove the soil in the pit, excavate to a minimum depth of 6 in. below the bottom of the pipe and replace the soil with bedding material.

If the bottom of the excavation becomes wet due to the presence of groundwater and a dewatering system is not required, and if directed, over excavate an additional 6 in. to a depth of 1 ft. below the bottom of the pipe. Place a non-woven geotextile fabric and then compact 12 in. of bank run sand or concrete sand in a single lift on top of the fabric. Compact the upper 6 in. to 90% of the standard maximum density as determined by Tex-113-E. The Engineer may require the Contractor to remove unstable or unsuitable material, even though the Contractor has not determined the material to be unsuitable.

Mechanically compact the bedding material by using vibratory equipment or any other acceptable equipment. Compact the bedding material to 95% of the standard density within 5% of the optimum moisture, as determined by Tex-113-E.

3.2.5.1.3. **Bedding Materials.** The following describes the acceptable materials for bedding:

- Section 2.14.1., “Bank Run Sand”
- Section 2.14.3., “Pea Gravel”

Bank run sand may be used as bedding material around the pipe only if, as determined by the Engineer, the trench bottom and sides are dry. If sand is used, place the pipe in the bedding so that there is at least 6 in. bedding around and on top of the pipe. Compact the sand as described in Section 3.2.5.1.1., “Open Cut Trench Installation.”

3.2.5.2. **Pipe Bedding for Water Mains 24 Inches or Greater in Diameter.**

Open Cut: Provide pipe bedding as described in Section 3.2.5.1., “Pipe Bedding for Water Mains Less Than 24 Inches in Diameter,” with the following exceptions: Use bank run sand for the bedding material as described in Section 2.14, “Bedding Material.”

Compact cement stabilized sand used as backfill or as pipe bedding as specified on the plans, in 6 in. lifts to 95% of the standard maximum density as determined by Tex-113-E, at the optimum moisture content.

3.3. **Handling Pipe and Accessories.** During pipe construction operations, use caution to prevent injury to the pipe, protective linings, and coatings in conformance with the manufacturer's recommendations. Do not place debris, tools, or other materials in the pipe.

Repair any damage to the pipe or the protective lining and coating from any cause during the installation of the pipeline and before final acceptance by the purchaser. Perform this work as directed, in conformance with the applicable standards, and at no cost to the Department.

Unload pipe, fittings, valves, and accessories at the point of delivery and haul them to the project site. Distribute the material opposite or near the place where it will be laid in the trench such that storm water or runoff will not enter or pass through the pipe. Do not drop the materials. Do not allow pipe handled on skid ways to be skidded or rolled against pipe already on the ground.

Load, transport, unload, and otherwise handle pipe and fittings in a manner and by methods which prevent damage of any kind. Handle and transport pipe with equipment designed, constructed, and arranged to prevent damage to the pipe, lining, and coating. Do not allow bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with the coatings. Provide pipe fittings with enough interior strutting or cross-bracing to prevent deflection under their own weight.

Hoist the pipe and fittings from the trench side into the trench by means of a sling of smooth steel cable, canvas, leather, nylon, or similar material. Do not lift pipe by using hooks at each end of the pipe. When stacking pipe, ensure it is packaged on timbers. Place protective pads place under the banding straps at the time of packaging.

When using fork trucks to relocate pipe, pad the forks using carpet or some other suitable type of material. When relocating pipe using a crane or backhoe, use nylon straps or smooth steel cable, do not use chains, around the pipe for lift.

3.4. **Cutting Pipe.** Cut pipe 12 in. in diameter and smaller in conformance with the manufacturer’s recommendations. Cut pipe larger than 12 in. in an approved manner. Perform each cut at right angles to the axis of the pipe and file or grind to remove sharp edges. Use a cutting machine unless otherwise approved by Engineer. Do not damage pipe or linings and coatings, while cutting.

3.5. **Defective or Damaged Material.** Inspect pipe and accessories for defects before lowering into the trench. Repair or replace any defective, damaged, or unsound material as directed.

If a damaged piece of pipe, furnished by the Contractor, is placed in the water main, furnish the labor and materials necessary to remove and replace the defective pipe and to restore the street to its original condition at no cost to the Department. If the Contractor damages the pipe after installation, the Engineer may permit the damaged section to be cut from the length, unless it is the opinion of the Engineer that the entire length was damaged. The cost of and replacement of broken pipe is at the expense of the Contractor.

3.6. **Cleaning Pipe and Accessories.** Remove lumps, blisters, and excess coating from the bell and spigot ends of steel pipe, ductile-iron pipe, valves, hydrants, and fittings. Wire brush the outside of the spigot and the inside of the bell and wipe clean, dry, and free from oil and grease before laying the pipe.

Remove foreign matter or dirt from the interior of water pipe, accessories, and from the mating surfaces of the joints, before lowering the material into the trench. Keep the pipe and accessories clean during and after laying by approved means.

Use cleaning solutions, detergents, solvents, etc. with caution when cleaning PVC pipe.

Provide cleanup and restoration crews to work closely behind the pipe laying crews, and where necessary, during disinfection, testing, service transfers, abandonment of old mains, backfilling, and surface restoration.

Upon completely installing a section not exceeding 4,000 ft. per crew, immediately prepare to disinfect and pressure test between valves or plugs. No later than 3 days after completing disinfection preparatory work, submit to the Utility Owner an appropriate request for disinfection.

Begin transfer of services no later than 7 calendar days after successfully completing the disinfection and pressure testing.

Immediately after transfer of services, begin abandonment of the old mains, including re-sodding and placing sidewalks and pavements.

Do not begin construction of additional sections if the above conditions are not met.

For large diameter water mains, do not install more than 2,000 ft. of main, until the previous 2,000 ft. is cleaned up and the site is fully restored. Schedule paving crews so that the repaving work will not lag behind the pipe laying work by more than 1,000 ft.

Completely restore the site within 30 days from the date the water main is successfully disinfected and hydrostatically tested, unless extended in writing by the Engineer.

For projects involving multiple locations, limit water main installation to a maximum of 2 project site locations.

Remove construction debris or foreign material and thoroughly clean and flush piping systems as approved. Provide temporary connections, equipment, and labor for cleaning. The Engineer must inspect the water main for cleanliness before filling.

Disinfection of Water Lines: Conform to the requirements of Section 3.17., “Disinfecting Mains and Testing for Leakage.”

3.7. **Laying Pipe.** For the work of laying the pipe, employ only workers who are skilled and experienced in laying pipe of the type and joint configuration being furnished. Provide watertight pipe and pipe joints. Lay pipe with the bell ends facing in the direction of laying, unless otherwise directed.

Lay pipe to the lines and grades shown on the plans. To ensure proper placement, use adequate surveying methods and equipment, and employ personnel competent in using this equipment. Ensure the pipe does not deviate from the horizontal and vertical alignment indicated on the plans by more than 0.10 ft., without prior approval. Measure and record the “as-built” horizontal alignment and vertical grade at a maximum of every 50 ft. on the on-site recorded plans.

During pipe laying operations, keep pipe trenches free of water which might impair the laying operations. Ensure holes for bells are of ample size to prevent the bells from coming in contact with the subgrade. Carefully grade pipe trenches to provide uniform support along the bottom of the pipe.

Do not lay more than 50 ft. of pipe in the trench ahead of the backfilling operations. If pipe laying operations are interrupted overnight, cover the pipe laid in the trench simultaneously on each side of the pipe or completely backfill, to avoid lateral displacement of the pipe and damage to the joints. If adjustment of the position of a length of pipe is required after it is laid, remove and re-lay it in conformance with these specifications and at no expense to the Department. After pipe laying and joining operations are complete, clean the inside of the pipe and remove debris.

Use care to prevent damage to the coating when placing backfill. Backfill in accordance with Section 3.11, “Backfilling.”

Lay pipe in a straight line unless otherwise shown or approved. Long radius curves, either horizontal or vertical, may be laid with standard pipe using deflections at the joints. If curved pipe is shown, needing no special fittings, the curves can be made by deflection of the joints with standard lengths of pipe as approved. If maximum pipe joint deflections are permitted, do not exceed the manufacturer's recommendation for maximum pipe joint deflections. Joint the gasketed pipe in a straight alignment and then deflect it to the curved alignment.

If the vertical deflection exceeds the maximum recommended by the manufacturer, remove the entire portion of the deflected pipe section and install new pipe as directed. Perform this work at no expense to the Department. The Engineer may measure assessment of deflection at any location along the pipe. Arithmetical averages of the vertical deflection or similar average measurement methods will not be deemed as meeting the intent of the standard.

Where field conditions require horizontal deflection curves not shown on the plans, the Engineer will determine the methods to be used.

No additional payment will be made for laying pipe on curves as shown, or for change orders involving standard lengths of pipe deflected at the joints. Adjust the pipe, valves, hydrants, and fittings to be at their proper locations and prepare each joint as specified in Section 3.8., "Joining Pipe and Accessories." As each joint of pipe is laid in the trench, center the spigot end in the bell of the previously laid pipe, then force home the pipe and bring it to the correct line and grade. Ensure each length of pipe rests on the bottom of the trench and is inspected for damage throughout its entire length.

When pipe lying is discontinued for the day or for an indefinite period, tightly place a cap or plug in the end of the last pipe laid to prevent the intrusion of water. When water is excluded from the interior of pipe, place enough backfill on the pipe to prevent floating. Schedule the work to prevent the possibility of floatation. Remove from the trench any pipe that has floated and re-lay as directed.

When assembling PVC pipe on top of the trench, allow it to cool to ground temperature before backfilling, to prevent pull-out due to thermal contraction.

Do not schedule night works or plant shut down to begin within 2 working days before or after Utility Owner-designated holidays.

For tie-ins to existing water mains, provide the necessary material on-hand to facilitate connection before shutting down the existing water main.

Ensure that separation from gravity sanitary sewers and manholes, or from force mains, is a minimum of 9 ft. clearance in all directions or as specified, unless a special design is shown on the plans.

Minimum Clearance of this specification:

- Parallel water line and gravity sanitary sewer force main, or manhole with no leaks:
  Minimum 4 ft. horizontal clearance from the outside wall of the water line to the outside wall of the gravity sanitary sewer, force main, or manhole.
- Water line crossing above gravity sanitary sewer or force main with no leaks:
  Minimum 2 ft. vertical clearance.
- Water line crossing below a sanitary sewer or force main with no leaks:
  Minimum 2 ft. vertical clearance.

3.8. **Joining Pipe and Accessories.**

3.8.1. **Ductile-Iron Pipe, Valves, Hydrants, and Fittings.** After thoroughly cleaning the inside of the bell and the outside of the spigot, install members in conformance with the manufacturer's recommendation and AWWA C600, or as modified by these specifications.

Mark pipe and accessories that are not furnished, with a depth mark before assembly to ensure that the spigot end is inserted to the full depth of the joint.

Brace the fittings on small mains with short pieces of 2 in. galvanized pipe as directed.

Brace each plug installed under this contract by a standard pipe clamp, a 3 ft. nipple of the same diameter pipe as the nearby sections of mains, and a block of concrete.

For 4 in. through 12 in. water mains, use pipe clamps that are Underwriters Lab-approved for underground water service piping. For water mains 16 in. and larger, use pipe clamps conforming to details shown on the plans.

For rubber-gasketed joints use lubrication that is water soluble, non-toxic, non-objectionable in taste and odor imparted to the fluid, non-supporting of bacteria growth, and has no deteriorating effect on coatings or rubber gaskets.

3.8.2. **Polyvinyl Chloride Pipe and Accessories.** Join plastic pipe in conformance with the instructions furnished by the manufacturer. To prevent weakening the joint, do not handle or install in the trench pipe joined using solvent cementing techniques, until the joints “cure.”

For rubber-gasketed joints, use lubrication that is water soluble, non-toxic, non-objectionable in taste and odor imparted to the fluid, non-supporting of bacteria growth, and has no deteriorating effect on PVC or rubber gaskets.

3.8.3. **Welded Joints for Steel Pipe.** Ensure the joints receive a full-penetration butt weld type double weld, in accordance with AWWA C206. It is the Contractor’s option to use either automatic or hand welders. Before starting the work, provide proof of certification of qualification for welders employed on the project for every type of work procedure and position involved. Ensure qualification is in accordance with AWWA C206. Ensure complete penetration of deposited metal with the base metal. Provide inside fittings and joints that are free from globules of weld metal that would restrict flow or become loose.

Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2.5°.

Set fittings and joints square and true, and preserve the alignment during welding operations. Align the butting ends to minimize the offset between surfaces. For pipe of the same nominal wall thickness, do not exceed 1/16 in. offset. Use line-up clamps for this purpose; however, exercise caution to avoid damaging to the linings and coatings.

Furnish each welder employed with a steel stencil for marking welds, so the work of each welder can be identified. Mark pipe with the assigned stencil adjacent to the weld. If a welder leaves the job, void that stencil and do not duplicate it. Welders making defective welds must discontinue work and leave the project site. Such welders may return to the project site only after recertification.

During welding, protect the lining by draping an 18 in. wide strip of heat-resistant material over the top half of the pipe on each side of the lining holdback to avoid damage to the lining by the hot splatter. Protect the tape coating similarly.

Provide welding rods of a type compatible with the metal being welded, to obtain the strongest bond, E-70XX.

Deposit the metal in successive layers so there will be at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in the completed weld.

On welds, do not deposit more than 1/4 in. of metal on each pass. Thoroughly clean the weld by wire brushing and hammering on each individual pass including the final one, to remove dirt, slag, or flux.

Do not perform welding under any weather condition that would impair the strength of the weld, such as wet surface, rain or snow, dust or high winds, unless the work is properly protected.

If using tack welds, ensure they are of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during the welding operation.

Remove dirt, scale, and other foreign matter from the inside of piping before tying in sections, fittings, or valves.

Provide a minimum overlap of 4 in. of butt strap over the adjacent piece on butt strap closures.

Employ an approved independent certified testing laboratory, to perform weld tests and associated work to accommodate testing on the entire job. Include the cost of such testing in the contract unit bid price for the water main. Furnish copies of test reports to the Engineer for review. Ensure testing is by X-ray methods for butt welds and is performed for every joint weld. If a defective weld is revealed, assume the cost of repairing and retesting the repaired weld. The Engineer has the full and final decision as to the suitability of welds tested. If any interior or exterior coating or lining is damaged during the welding process, repair it and return it to its original state as approved, in conformance with applicable AWWA standards.

Provide cylindrical corrosion barriers (CCBs) for epoxy-lined steel pipe smaller than 24 in. in diameter. Furnish CCBs manufactured by CCB International, Inc., or approved equal. CCBs are not required if the minimum wall thickness is 1/2 in. or greater.

In addition to the welding requirements contained in this specification, conform to the protection fitting manufacturer's installation recommendations.

Provide the services of a technical representative of the manufacturer available on site at beginning of pipe laying operations. Ensure this representative is able to train welders and advise regarding installation and general construction methods. Employ only welders with at least 12 mo. experience installing protection fittings.

3.8.4. **Flanged Joints for Steel Pipe.** Before installing bolts, accurately center the flange joints and align them to prevent mechanical pre-stressing of flanges, pipe, and appurtenances. Align bolt holes to straddle the vertical, horizontal, or north-south, centerline. The maximum inclination of the flange face from the true alignment is 3/64 in. per foot.

Use full-face gaskets for flanged joints. Provide 1/8 in. thick cloth inserted rubber gasket material. Cut the gaskets at the factory to the proper dimensions.

Unless otherwise noted, provide insulation kits at connections to the existing water system or at locations to isolate one type of cathodic system from another type; between water line, access manhole piping, and other major openings in the water line; or as shown on the plans.

For isolating flange joints 30 in. in diameter and greater, and at butterfly valve flanges, provide a Pyrox G-10 with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal, conforming to ANSI A 21.11 mechanical joint gaskets. For isolating flange joints 24 in. in diameter and smaller, provide a Phenolic PSI with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal, conforming to ANSI A 21.11 mechanical joint gaskets.

Use galvanized or black nuts and bolts to match the flange material. Use cadmium-plated steel nuts and bolts underground. Tighten the bolts progressively to prevent unbalanced stress. Consistently maintain approximately same distance between the two flanges at all points around the flanges. Tighten the bolts alternately (180° apart) until they are evenly tight. Draw the bolts right to ensure properly seating the gaskets. Provide Denso, or approved equal, petroleum-based tape wrapping system for nuts and bolts.

Pay particular attention to procedures used in tightening and torqueing flanged joints. Improper methods may result in leakage and require corrective measures. Follow recommended industry standards and guidelines as set forth by the various fabricators and manufacturers.

3.8.5. **Flanged Joints For Use On Ductile-Iron Pipe.** See the requirements of Section 3.8.4., "Flanged Joints for Steel Pipe."

3.9. **Thrust Restraint.** Provide adequate temporary blocking of fittings when making connections to the distribution system and during hydrostatic tests. Provide enough anchorage and blocking to resist stresses and forces encountered while tapping the existing waterline. For new waterlines 16 in. in diameter and larger, provide restraining joints as specified in this section. Provide restrained joint lengths as shown on the plans or as directed. For existing waterlines and waterlines less than 16 in. in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in this section.

The length of the restrained joints shown on the plans, assumes that hydrostatic testing will begin upstream and proceed downstream with respect to the normal flow of the water in the pipe. If installation or testing of the pipe differs from this assumption, submit for approval a revised method of restraining the pipe joints upstream and downstream of the device used to test against (i.e., block valve, blind flange, or dished head plug).

3.10. **Electrical Continuity Bonds.**

3.10.1. **General.** Attach the bond wires at the required locations using the Thermite welding process.

3.10.2. **Thermite Welding Methods.** Perform Thermite welding of bond wires to the piping in the following manner:

Ensure the pipe to which the wires will be attached is clean and dry. Use a grinding wheel to remove coating, mill scale, oxide, grease, and dirt from an area approximately 3 in. square. Grind the surface to bright metal.

Remove approximately 1 in. of insulation from each end of the wires to be Thermite welded to the structure, exposing clean, oxide-free copper for welding.

Select the proper size Thermite weld mold as recommended by the manufacturer. Place the wire between the graphite mold and the prepared metal surface. For No. 12 AWG size wires, use a copper sleeve crimped over the wire. Place the metal disk in the bottom of the mold. Place the Thermite weld charge in the mold. Squeeze the bottom of the cartridge to spread ignition powder over the charge.

Close the mold cover and ignite the starting powder with a flint gun. After the exothermic reaction, remove the Thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure with a new wire. If the weld is secure, coat bare metal and weld metal with a coal-tar compound. If a polyurethane dielectric coating has been used, use a compatible polyurethane coating.

3.11. **Backfilling.**

3.11.1. **General.** Backfill trenches in accordance with the requirements of Item 400.

Begin backfilling and cleaning up each section of main, i.e., from valve to valve, immediately upon the completing the hydrostatic test, unless otherwise permitted by Engineer, and continue until obtaining a final and complete clean-up of the section. Any portion of the trench that is left open in excess of that required to facilitate hydrostatic testing may be ordered closed by the Engineer.

Use surplus excavated materials in the embankments or dispose of them as directed.

3.11.2. **Backfilling Pipe for Water Mains.**

3.11.2.1. **Open Cut.** After the pipe joints are made up and inspected, backfill the trenches with excavated materials or any other backfill material covered by this specification, as approved. Backfill the portion from the spring line of the pipe (or from 6 in. on top of pipe if sand bedding is used) to the top of the trench in maximum lifts of 9 in. loose measurement (provided the trench is not located in sidewalks, roadways, roadway shoulders, driveways, etc. that are being used for automobile or pedestrian traffic). Mechanically compact the backfill material using vibratory equipment, or any other acceptable equipment, so that no settlement occurs. Compact to a density of at least 95% of the maximum dry density, as determined in accordance with Tex-114-E. The Engineer reserves the right to perform compaction tests on an as-needed basis. Compaction by water tamping is prohibited.

Do not allow dirt, clods, or trench sides to fall or rest against the pipe before completing the embedment or backfill.

The allowable materials for backfill are listed in Section 2.15, “Backfill Material.”

Continue backfilling and compacting in this manner to the minimum elevation shown in the excavation and backfill diagram.

3.11.2.2. **Boring or Augering Pits**. Backfill boring or augering pits with bank run sand up to 1 ft. from the top of the natural ground. For the final 12 in., use backfill consisting of 10 in. of native soil in the bottom and 2 in. of bank run sand just below the grass.

Backfill the portion from the spring line of the pipe to the top of the pit in lifts not exceeding 9 in. (loose measurement). Mechanically compact the backfill by using vibratory equipment, or any other acceptable equipment, so that no settlement occurs. Compact the material to a density of at least 95% of the maximum dry density at optimum moisture content as determined in accordance with Tex-113-E or Tex-114-E. The Utility Owner may perform compaction tests on an as-needed basis. Compaction by water tamping is prohibited.

Do not allow dirt, clods, or auger pit sides to fall or rest against the pipe before completing the embedment or backfill.

The only allowable material for backfill in boring or augering pits is bank run sand, described in Section 2.15, “Backfill Material.”

3.12. **Valves and Fire Hydrants.** Ensure each valve and fire hydrant is completely closed when placed in the pipe line.

Install valves and hydrants in accordance with AWWA C600, except where modified by this specification. Provide drainage at the base of the hydrant in accordance with AWWA C600.

Set each hydrant at the location and grade indicated by the stakes, and plumb, brace, and install in accordance with AWWA’s requirements for fire hydrant installation. If the barrel of a hydrant is to pass through a concrete slab, fit a piece of 1 in. thick pre formed bituminous expansion joint material closely around the section of the barrel passing through the concrete.

Locate the nozzle centerline a minimum of 18 in. above the finish grade.

Place 12 in. x 12 in. yellow indicators (plastic, sheet metal, plywood, or other approved material) on pumper nozzles of new or relocated fire hydrants installed on new mains not in service. Remove indicators after the new main is tested and approved.

3.13. **Tapping Sleeves and Valves.**

3.13.1. **General.** Install tapping sleeves and valves at the locations and using the sizes shown on the plans. Thoroughly clean the tapping sleeve, tapping valve, and pipe in conformance with the manufacturer's instructions before installing.

Hydrostatically test the installed tapping sleeve to 150 psig for a minimum of 15 minutes. Inspect the sleeve for leaks, and remedy any leaks before the tapping operation.

When tapping concrete pressure pipe, size on size, use a shell cutter one standard size smaller than that of the water line being tapped. Do not use Large End Bell (LEB) increases with a next size tap except for existing asbestos-cement pipe.

3.13.2. **Installation.** Verify the outside diameter of the pipe to be tapped before ordering the sleeve. Tighten the bolts in the proper sequence to avoid placing undue stress on the pipe. Align the tapping valve properly and attach it to the tapping sleeve. Insert the insulation sleeve into the flange holes of the tapping valve and pipe. Insert the sleeve on pipe side of tapping valve. Do not damage insulation sleeves during the bolt tightening process.

Make the tap with a sharp shell cutter using the following criteria: For 12 in. and smaller taps use a minimum cutter diameter 1/2 in. less than the nominal tap size. For 16 in. and larger taps, use the manufacturer's recommended cutter diameter.

Withdraw the coupon and flush the cuttings from the newly-made tap. For 12 in. and smaller taps, wrap the completed tapping sleeve and valve in accordance with this specification.

For 16 in. and larger taps, apply Denso or approved equal, petroleum-based tape wrapping system around the completed tapping sleeve and valve. Place the concrete thrust block behind the tapping sleeve (not over the tapping sleeve and valve).

Arrange for the mandatory inspection of the installation before backfilling. Completion of the inspection is not required before backfilling. Backfill in accordance with this specification and as shown on the plans.

If Asbestos-Cement (AC) Pipe is encountered, follow the Safety Practice outlined in the Asbestos-Cement Pipe Producers Association publication, "Recommended Work Practices for A/C Pipe," and make them "Mandatory Practices" for this project.

3.14. **Boxes for Valves.** Cut the cast-iron or ductile-iron pipe to the proper length, then assemble and brace the box as approved. Construct manholes over the operators of butterfly valves for sizes 30 in. and larger.

Concrete for valve box placement: For locations in new concrete pavement, use the same strength and mix design as that of new pavement. For other locations, use Class "A" Concrete, conforming to the requirements of Item 421.

Install valve box and riser piping plumbed in a vertical position. Provide 6 in. telescoping freeboard space between the riser pipe top butt end and the interior contact flange of the valve box, for vertical movement damping. Ensure the riser (bell end of pipe) rests on the valve flange, or provide a suitable foot piece to support the riser pipe.

Set, align, and adjust the valve box so that the lid is level with the final grade.

Paint the covers of new valve boxes in "Fluorescent Orange" when installed. After completion and approval by the Engineer, repaint the covers in "Black."

3.15. **Wet Connections**. Make the wet connections, as directed, in such a manner and at such hours to minimize inconvenience to the public. When the existing mains have been cut or a plug removed for a connection, pursue the work of making the connection without interruption until complete.

If the Contractor proceeds with a wet connection without a complete shut-off, there will be no extra compensation for damages or extra work resulting from the incomplete shut-off.

The Utility Owner will operate gate valves in the existing system and in sections of completed mains that have been placed in service. Notify the Utility Owner at least 48 hr. in advance of making connections.

Wet connections that are 2 in. or smaller are sometimes referred to on the plans as 2 in. standard connections or gooseneck connections.

Items that may be necessary to complete these types of wet connections include corporation cock, saddle, copper tubing, brass fittings, and 2 in. valves. Do not use these connections on or consider them as part of a 2 in. service line.

The Utility Owner will handle, at no cost to the Contractor, operations involving opening and closing valves for wet connections.

3.16. **Polyethylene Film Wrap.** Except as noted on the plans, wrap ductile-iron pipe (including fittings and other appurtenances), with a polyethylene film. Also wrap fire hydrant barrels.

Remove lumps of clay, mud, cinders, etc., on the pipe surface before installing the polyethylene encasement. Prevent soil or embedment material from becoming trapped between the pipe and the polyethylene. Fit the polyethylene film to the contour of the pipe to affect a snug, but not tight fit; encase with minimum space between the polyethylene and the pipe. Provide enough slack in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.

For installations below the water table and in areas subject to tidal actions, seal both ends of the polyethylene tube with adhesive tape at the joint overlap.

Repairs: Repair any cuts, tears, punctures, or damage to the polyethylene with adhesive tape or with a short length of polyethylene sheet or cut open tube, wrapped around the pipe to cover the damaged area, and secured in place.

Openings in Encasement: Provide openings for branches, service taps, blow offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as other damaged areas in the polyethylene, with tape. Service taps may also be made directly through the polyethylene. Repair any resulting damaged areas as described above.

Junctions between Wrapped and Unwrapped Pipe: Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover the adjacent pipe for distance of at least 3 ft. Secure the end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for a minimum clear distance of 3 ft. away from cast-iron or ductile-iron pipe..

3.16.1. **Tubular Type Wrap.** When the polyethylene film is supplied in tubular form, install it on the pipe before placing the pipe in the trench and in the following manner:

Elevate the spigot end of the pipe, brush mud and debris from the pipe, and slip a length of film (approximately 2 ft. longer than the joint of pipe) over the joint of the pipe. Wrap the film tightly around the spigot end, leaving about 1 ft. extending beyond the end of the pipe, and tape the edge down lightly with polyethylene tape.

When lifting the joint of pipe for placing in the trench, remove any remaining mud, clay, or debris. Insert the spigot end into the bell end of the joint previously placed, push home, and release the pipe into the trench. Pick up the pipe joint at the bell, slide the film to a point back of the bell, and prepare a bell hole.

When laying the next joint, pull the film beyond the bell to overlap the film attached to the spigot of the new pipe joint. Wrap the film by folding it longitudinally and tape it securely in place to prevent damage during backfill. Do not tape the end that is slipped over the last bell but bind it with twine or other approved material.

At each corporation, draw the loose material up around the corporation base and seal it with tape to insulate the 2 dissimilar metals.

Wrap fittings and fire hydrant leads, and tape or bind the wrap with heavy twine. Wrap fittings, such as bends and reducers, similarly to the method outlined above. Wrap specials, such as valves, tees, crosses, etc., by splitting, tucking, and overlapping the polyethylene tube, then closing the field-made splices with the required tape. Material to cover the valves may be acquired from excess overlapping polyethylene tubing on adjacent pipe joints. Draw the polyethylene tubing over the bell of the pipe on either side and insulate with field-made seams as described above. Completely wrap fittings and specials that require concrete blocking, before placing concrete.

3.16.2. **Sheet Type Wrap.** Apply sheet type wrap around the pipe either before or after positioning the pipe in the trench. Install “above ground” in a manner similar to that described above for tubular installation. Install “in trench” in a manner similar to that described below:

Cut the polyethylene sheet to a length approximately 2 ft. longer than the pipe section. Center the length to provide a 1 ft. overlap on each adjacent pipe section, bunching it until it clears the pipe ends. Wrap the polyethylene around the pipe so that it circumferentially overlaps the top quadrant of the pipe. Secure the cut edge of the polyethylene sheet at intervals of approximately 3 ft.

Lower the wrapped pipe into the trench and make up the pipe joint with the preceding section of pipe. Make shallow bell holes at joints to facilitate installation of the polyethylene. After completing the joint, make the overlap and secure the ends.

Repair cuts, tears, punctures, or other damage to the polyethylene. Proceed with installing the next section of pipe in the same manner.

3.16.3. **Boring or Augering Section Installation.** Use cast-iron or ductile-iron pipe with a polyurethane coating as specified in this Specification.

Provide a final seal against the intrusion of the backfill material by completely encasing the tapping sleeve with sheet vinyl of 8 mil thickness. Apply tape to secure this wrapping, using Polyken No. 900, Scotch Wrap No. 50, or approved equal, manufactured for this purpose.

3.17. **Disinfecting Mains and Testing for Leakage.**

3.17.1. **Disinfecting Mains.** The Utility Owner will furnish water for disinfecting and flushing without charge to the Contractor.

Furnish the necessary taps, risers, and jumpers of such sizes and materials as are specified by the Engineer, and install the subject material in the locations designated. Normally, each valve section of main will require two 3/4 in. taps; however, on larger mains the Engineer may order that 1-1/2 in. or 2 in. taps and risers be used.

Furnish and install the necessary temporary blind flanges, sleeves, plugs, etc., as required to disinfect and pressure test the new mains.

Use fire hydrants as blow-offs to flush newly constructed waterlines 8 in. diameter and above.

After laying and backfilling the pipe, disinfect the newly laid pipe. Unless otherwise shown on the plans, the Utility Owner will furnish and pay for the labor and materials necessary for the initial application of the disinfecting agent. Slowly fill each valves section of pipe with water and expel the air from the pipe. Furnish

and install taps at the points of highest elevation, if required to accomplish this. After filling the main with water and expelling the air, charge the pipe with the disinfecting agent and allow it to stand for 24 hr. Unless otherwise shown on the plans, the Utility Owner will then flush the main with water. After flushing, draw samples from the main and test for 2 consecutive days at a valid, approved testing facility. After samples are drawn and the test results pass, proceed with the pressure test and any necessary repairs. If the samples do not pass, re-disinfect the pipe until the samples taken are passed by the certified and approved testing facility. Unless otherwise shown on the plans, in the event that more than one disinfection of the main (or portion of the main) is required, the additional disinfection will be charged to the Contractor at rates established by the Utility Owner.

After disinfecting and flushing water lines, bacteriological tests will be performed by the Utility Owner or testing laboratory.

When test results indicate a need for additional disinfection of water lines based on Texas Department of Health requirements, assist Utility Owner with additional disinfection operations.

3.17.2. **Testing for Leakage.** Following the first disinfection test, subject the newly laid pipes to a hydrostatic pressure of 125 psi, unless otherwise shown on the plans. Where practicable, test pipe lines in lengths between line valves or plugs, of at most 1,500 ft. unless otherwise approved. Perform the pressure test by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Furnish, install, and operate the necessary connections, pump, meter, and gauges. Before running the pressure test, ensure the meter is tested, sealed, and approved (at the Contractor's expense) by an approved, certified testing facility. Ensure the minimum duration of the test is 8 hr. If a large quantity of water is required to maintain pressure during the test, discontinue testing until the cause of the water loss is identified and corrected.

Observe the following general regulations during each leakage test for cast-iron, ductile-iron, and PVC pipe:

Except for welded steel pipe in which no leakage is permitted, ensure that pipe lines, when subjected to the specified pressure test, do not show leakage in excess of 3.19 gal. per inch of diameter, per mi., in 24 hrs.

Repair portions of the pipe showing visible leaks regardless of the total leakage shown by the pressure test. Remove and replace cracked or defective pipes, fittings, valves, or hydrants discovered by means of this pressure test with sound material. If the main is opened for any reason, re-disinfect it until satisfactory samples are obtained. Also, pressure tests it until the requirements of this specification are met.

Immediately upon completing disinfection and pressure testing, remove all taps, risers, and blow-offs, then backfill the remainder of the trench in accordance with the requirements of this specification.

Perform leakage testing at no additional cost to the Department.

3.18. **Using Completed Sections of Mains.** The Utility Owner may use and operate portions of the water mains that are disinfected and pass the leakage test. Unless otherwise shown on the plans, operate the valves in such completed sections only with the express permission of the Utility Owner.

The use of the mains is not construed as acceptance of them and does not relieve the Contractor's responsibility for fulfilling the conditions of the contract, unless the mains are damaged due to negligence on the part of the Utility Owner.

3.19. **Lowering Mains.** When lowering a main, perform the initial excavation in such a manner to permit the mains to rest on a number of dirt benches. If soil conditions are unsatisfactory for dirt benches, use wooden blocks to support the mains. Then attach the pipe by using ropes, cable, or chains to overhead supports; remove the dirt benches or wooden blocks, and slowly and evenly lower the pipe into position. After lowering the mains, repair each damaged joint as directed.

3.20. **Copper Service Line Construction.** The use of Hays-Seal and Mueller Company catalog numbers to describe various fittings is not intended to be proprietary, but merely to indicate clearly the respective types of fittings to be furnished.

3.20.1. **Installing Service Lines.** For curb and gutter streets, lay copper service lines with a minimum 30 in. of cover from top of curb to the top of the service line. For crowned streets with open ditches, lay copper service lines with a minimum 30 in. of cover at the crown and with a minimum 18 in. of cover from the flow line of the ditch to the top of the service line. Ensure service line locations are clear of proposed paving and underground work.

Exercise caution to keep the lines free of dirt and foreign matter at all times. Assemble copper lines in an entirely slack position and free of kinks. Use service lines consisting of one continuous run of copper tubing where possible. Do not use bends greater than that originally found in the coil of tubing as packaged.

For 1-1/2 in. and 2 in. copper tubing shipped in straight lengths, use the following bend criteria:

For 2 in. copper tubing, a maximum of one 45° bend may be accomplished in a 4 ft. section; for 1-1/2 in. copper tubing, a maximum of one 45° bend in a 3 ft. section. No kinks, dents, flats, or crimps will be permitted.

Locate meters, in general, 1 ft. into the street right of way. Where this is not applicable, locate meters approximately 1 ft. from the sidewalk on the curb side. If the present meter location conflicts with proposed driveway turnouts or other proposed street improvements, shift the meter to miss the obstruction and reconnect it to the customer's service line. Reset meters at positions such that the top of the meter is 4 in. to 6 in. below the finished grade.

Where the plans call for salvaging and relocating the meter, meter box, and curb stop, remove these materials with care, thoroughly clean them, and submit them for inspection by the Engineer, before installing them in the new location. If the plans call for relocating the meter (other than at some point along the existing service line), a new service line will be required.

Where it is necessary to cross a paved street, push the service line under the paving through a pre-drilled and prepared opening. Use only full lengths of copper tubing, taking care not to damage the tubing when pulling it through the prepared hole.

A compression type union is only permitted when a full 40 ft. (60 ft. for 3/4 in. to 1 in.) length of tubing cannot completely span underneath the pavement. Do not use compression type unions under the paved street.

3.20.2. **Installing Corporation Stops.** Tap the main at a location such that a straight line passing through the meter and the corporation stop will be at 90° to the main. Locate taps in the upper portion of the main within 45° of the pipe spring line. Perform the cutting operation with an approved sharp shell cutter tool.

Install taps for service lines conforming to the requirements of Table 12. Space taps a minimum of 2 ft. apart.

Table 12
Service Tap Requirements for Service Lines

Water Main Type and Diameter	Service Size Diameter			
	3/4 in.	1 in.	1-1/2 in.	2 in.
4 in. Cast-Iron or Ductile-Iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
4 in. Asbestos-Cement	WBSS	WBSS	DSS, WBSS	DSS, WBSS
4 in. PVC (AWWA C 900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6 in. and 8 in. Cast-Iron or Ductile-Iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6 in. and 8 in. Asbestos-Cement	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6 in. and 8 in. Cast-Iron or Ductile-Iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6 in. and 8 in. PVC (AWWA C900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12 in. Cast-Iron or Ductile-Iron	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12 in. Asbestos-Cement	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12 in. PVC (AWWA C900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
16 in. and up Cast-Iron or Ductile-Iron	DWBSS	DWBSS	DWBSS	DWBSS
16 in. and up Asbestos-Cement	DWBSS	DWBSS	DWBSS	DWBSS
16 in. and up PVC (AWWA C900)	DWBSS	DWBSS	DWBSS	DWBSS
DSS – Dual Strap Saddles WBSS – Wide Band Strap Saddles DWBSS – Dual Wide Band Strap Saddles				

3.20.3. **Installing Curb Stops.** Set curb stops or angle stops only at the outer end of the service line just ahead of the meter. Secure the opening in the curb stop to prevent unwanted material from entering. Use eighth bend or quarter bend couplings to accomplish close quarter turns in the service line.

In 3/4 in. and 1 in. services, install a meter coupling or swivel nut meter spud curb stop, ahead of the meter. Also install a straight meter coupling on the outlet end of the meter. Install a new curb stop when the service line is extended.

3.20.4. **Sequence of Work.** Open the trench for the proposed service line or prepare the jacking and receiving pits.

Install the corporation stop in a workmanlike manner using the proper equipment.

Install the copper service line and connect it to the corporation stop.

Install the curb stop on the meter end of the service line.

With the curb stop open, and before connecting the service line to the meter, open the corporations stop and flush the service line adequately. Close the curb stop, leaving the corporation stop in the full open position.

Check the service line for apparent leaks. Repair leaks before proceeding.

Connect the service line to the meter and, if necessary, adjust the meter location. Use care to ensure that the inlet side of the meter is connected to the water service line. Momentarily open the curb stop to verify proper registration of the meter.

Backfill the excavations, tamping the backfill material in place to the density of the soil in the adjacent trench walls.

If relocating the meter, relocate the meter box so that it is centered over the meter with the top of the lid flush with the finished grade. When the meter must be located in driveways or sidewalks furnish and install an approved traffic type meter box with a cast-iron lid.

3.21. **Cutting and Plugging Water Mains.** Where the plans call for abandoning water mains, adhere to the following general procedure:

After constructing, disinfecting, testing, and placing the replacement main in service, and services are transferred to the replacement main, locate the main to be abandoned, trace it back to the feeder main, and

at this point cut and plug it at the tee. Normally, installing a plug, clamp, and a concrete thrust block does this. In cases of 1-1/2 in. or 2 in. corporation cock or tapping sleeve and valve (TS&V) connections, remove the valve and install a cap or plug at the tee. Ensure the line to be abandoned is not valves off at the nearest valve, nor cut and plugged other than at the supply main.

Adequately plug the ends or openings in abandoned mains or cap them in an approved manner and replace excavation, backfill, and any street surfaces, to the Engineer's satisfaction. Perform this work in accordance with Sections 3.1., "Excavation," and 3.11., "Backfilling."

Remove surface identification, i.e., valve boxes and fire hydrants. Where valve boxes are in improved streets (other than shell), pouring valve boxes full of concrete with the cap permanently removed is permitted.

Do not remove plugs during the months of peak water demands, June, July, and August, unless otherwise approved

3.22. **Service Lines of Public Utilities.** Where any pipe or conduit of a public utility corporation crosses the water main trench, support such pipe or conduit in a manner satisfactory to the Engineer.

If the Contractor considers it necessary for a utility company to relocate their utility lines or other improvements, notify the Engineer in advance.

If the Engineer considers it imperative to make the change, the Engineer will make the necessary arrangements with the utility company.

3.23. **Relocating Meter Vaults.** Salvage existing valves, meters, and strainers from inside the vault and return them to the Utility Owner, or as designated on the plans.

Install pipe, valves, service lines, and other appurtenances in accordance with the sections of this specification or as directed.

In general, install the type of meter vault shown on the plans or as approved.

3.23.1. **Precast Concrete Vault.** Construct and furnish the precast concrete vault as shown on the plans.

Set the precast concrete vault level on a minimum 3 in. bed of sand in an excavation and bring it to grade. Then install piping and backfill with sand around the vault.

3.23.2. **Cast-in-Place Concrete Vault.** Construct the cast-in-place concrete vault as shown on the plans. Key the walls to the floor slab and form to the dimensions shown on the plans. Provide a minimum wall thickness of 4 in. Cast the walls monolithically. One cold joint is allowed when the vault depth exceeds 12 ft. Set the frame for the cover while the concrete is still green.

3.23.3. **Frame and Cover.** Construct the frame and cover as shown on the plans.

In grass areas, set the frame and cover 2 in. to 3 in. above the natural ground or finished grade and parallel to it (the maximum allowable angle from horizontal is 20°). Slope the backfill away from the meter.

In sidewalk areas, set the frame and cover 1/2 in. to 1 in. above the adjacent concrete and parallel to it. Slope the replacement concrete away from the meter to meet the adjacent concrete.

3.23.4. **Inspections.** The following inspections will be made jointly by the Engineer and representatives of the Utility Owner:

- Site Location Inspection - to obtain the required approval of proposed meter location before commencing work.
- Final Inspection – conducted after the backfill is in place, the cover is installed, the cleanup is completed, and the surface is restored.

3.24. **Adjusting Existing Surface Structures.**

3.24.1. **Valve Boxes.** Salvage and reuse the valve box. Remove and replace the 6 in. ductile-iron riser pipe with a suitable length for the depth of cover required to establish the adjusted elevation to accommodate the actual finished grade.

Reinstall the valve box and riser piping plumbed in a vertical position. Provide a minimum of 6 in. telescoping freeboard space between the riser pipe top butt end and the interior contact flange of the valve box, for vertical movement damping.

After setting, aligning, and adjusting the valve box so that the top lid is level with the final grade, place a 24 in. by 24 in. by 8 in. thick concrete block around the valve box. Center the valve box horizontally within the concrete box.

3.24.2. **Meter Boxes.** Salvage and reuse meter boxes when possible. Reinstall them in conformance with the manufacturer's recommendations. Repair any damage sustained by the meter box during relocation or service transfer, at no expense to the Department.

If the existing meter box requires replacement, the Contractor may obtain a new box from the Utility Owner by providing adequate documentation of the existing and proposed locations.

3.24.3. **Meter Vaults.** Adjust meter vaults in conformance with the details shown on the plans. Salvage and reuse access covers.

3.25. **Relocating Water Meters and Boxes.** Salvage, clean, inspect, and install existing curb stops, meters, unions, and meter boxes at the new locations in conformance with specifications in this section. When the meter and box is relocated, move it the minimum distance to enable access for new connections. Repair any damage sustained by the meter box during relocation or service transfer, at no expense to the Department.

If unable to salvage the existing boxes, the Contractor may obtain new boxes from the Utility Owner by providing proper documentation of the existing and proposed locations of the meter.

When approved, the Contractor may relocate meter boxes located adjacent to existing pavement, if this operation facilitates construction or decreases the costs. Obtain written approval of the Engineer and perform this work, including excavation, piping, meter box relocation, removal and replacement of paving, etc., at no cost to the Department.

3.26. **Installing Split Casing.** Notify the Utility Owner at least 48 hr. in advance of any work planned involving existing water lines. Do not, at any one time, expose more than 20 ft. of water lines to be encased.

Place 6 in. x 6 in. x 1-1/4 in. neoprene pads between the split casing sections and the top and bottom of the water lines spacing them at approximately 6 ft. or as directed.

Ensure the completed and shaped trench to receive the casing is of wide enough to provide free working space for satisfactorily installing the casing and backfilling under and around the casing.

Hold the split casing in place for welding by using hinges, coupling bands, or any other acceptable method.

Use a casing diameter not less that the outside dimension of the pipe at is longest dimension plus 4 in.

Perform welds conforming to the requirements of AWWA Standard C 206. Provide welds capable of developing the full strength of the pipe throughout the joint and casing split.

Seal the ends of the encasement pipe with casing and seals in accordance with Section 2.2.1., "Steel Carrier Pipe," to prevent the entrance of the excessive ground water.

3.27. **Modifications for Cathodic Protection.**

3.27.1. **General.** Provide cathodic protection systems as shown on the plans.

References to steel pipe apply to tape-coated welded steel pipe. If damage occurs to the pipe coatings during the welding process, refurbish the affected area to its original condition.

3.27.2. **Bonded Joints.** Where rubber gasket bell and spigots are provided, provide for bonded joints by either welding a strap or clip between the bell and the spigot of each joint, or by providing a Thermite-welded cable between the bell and the spigot of each joint. Provide pipes, whether installed in a tunnel or open cut, with bonded joints, except where providing insulating flanges. Where welding joints for thrust restraint, no additional bonding is required.

Bonding Strap or Clip: Provide a strap or clip for bonding the bell to the spigot, that is free of foreign material that could increase the contact resistance between the wire and the strap or clip.

Unless otherwise noted, provide insulation kits at connections to the existing water system, at locations to isolate one type of cathodic system from another type, between the water main and extra piping, or as shown on the plans.

3.28. **Removing and Salvaging Fire Hydrants and Water Meters.** Deliver removed and salvaged fire hydrants and water meters to the Utility Owner at the location shown on the plans, or as directed.

3.29. **Installing the Nonmetallic Pipe Detection System.** Install the nonmetallic pipe detection system concurrently with placing the proposed pipe. Install as specified by the manufacturer and as approved.

3.30. **Removing Water Mains and Removing Water Mains with Casing.** Remove water mains and water mains with casing in accordance with Item 100, or as shown on the plans. This includes removing and disposing of pipe and appurtenances as shown on the plans or as directed. Perform related excavation and backfilling, as required, at no additional cost the Department.

3.31. **Adjusting Manholes.** Perform work in accordance with Item 465. Excavate and backfill in accordance with Item 400. Carefully remove and temporarily store as directed, manhole and inlet rings, covers, plates, and grates to be reused. Clean mortar and grease from the contact areas of reused items. Dispose of unused removed material as directed. Use construction methods described in Sections 479.3.1, “Lowering the Top of a Manhole or Inlet,” and 479.3.2, “Raising the Top of a Manhole or Inlet,” unless otherwise shown on the plans.

3.31.1. **Lowering the Top of a Manhole or Inlet.** Remove a sufficient depth of brick courses or concrete to permit reconstruction on a batter not exceeding 1 in. horizontal to 2 in. vertical. Where brickwork is present, clean the mortar from the top course of brick. Rebuild the manhole or inlet to the original top dimensions or to the dimensions shown in the plans. Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour.

3.31.2. **Raising the Top of a Manhole or Inlet.** Clean the top surface of brick or concrete. Construct to the proper new elevation using new brick, brick salvaged from other manholes or inlets, prefabricated metal extension rings, concrete rings, or Class A concrete. Install the manhole or inlet ring and the cover, plate, or grate to conform to the proposed new surface contour. Install prefabricated extension rings in accordance with manufacturer’s instructions.

4. MEASUREMENT

4.1. **Water Main Pipe and Steel Casing.** Measured by the foot, of the various sizes and types specified. Water mains and casing will be measured along the axis of the pipe and no deductions will be made for valves or fittings. Reducers will be classed as pipe of the size of the larger end.

Unless otherwise shown on the plans, Fire Hydrant Branches (Leads) will be measured by the foot, of the various types and installation methods specified, along the axis of each branch (lead) from the hydrant to the end of the branch (lead). No deductions will be made for valves or fittings.

4.2. **Split Steel Casing.** Measured by the foot, of the various sizes shown on the plans.

4.3. **Fiberglass Reinforced Plastic (FRP) Pipe for Casing.** Measured by the foot, of the various sizes shown on the plans.

4.4. **Jacking, Tunneling, Boring, or Augering.** Jacking, Tunneling, Boring, or Augering for water mains and steel casing will be measured by the foot, of the sizes, types, and wall thickness (applicable only for casing) specified.

Jacking, Tunneling, Boring, or Augering for fire hydrant branches (leads) will be measured by the foot, of the various types specified.

4.5. **New Copper Service Lines.** Measured by each service line installed.

Short Side service line refers to service connections made to meters located on the same side of the street as the supply main is located. Long Side service line refers to service connections made to meters located on the opposite side of the street from the supply main, or from the center of the street, where the supply main is located in the center of the street.

4.6. **Gate Valves, Tapping Sleeves and Valves, and Butterfly Valves.** Measured by each assembly installed, of the various sizes specified, except that gate valves 20 in. in diameter and smaller, are subsidiary to the water lines.

4.7. **Fire Hydrants.** Measured by each assembly installed, including a 6-in. gate valve and box, regardless of depth. It is the Contractor's responsibility to install the fire hydrant assembly such that it meets the standard installation requirements of this specification and the manufacturer's specifications.

Fire Hydrant Branches (Leads) will be measured as indicated in Sections 4.1., "Water Main Pipe and Steel Casing" and 4.4., "Jacking, Tunneling, Boring, or Augering."

4.8. **Meters and Vaults.** Measured by each assembly constructed.

4.9. **Air Release and Vacuum Relief Valves.** Measured by each assembly, of the various sizes, with the valve box installed.

4.10. **Pressure Reducing Stations.** Measured by the lump sum unit constructed.

4.11. **Blow Off Valves.** Measured by each assembly, of the various sizes and types, with the valve box installed.

4.12. **Removing Fire Hydrants.** Measured by each assembly removed and disposed of properly.

4.13. **Removing Water Valves and Boxes.** Measured by each assembly removed and disposed of properly.

4.14. **Removing and Relocating Meters and Boxes.** Measured by each assembly removed, cleaned, and installed at the new location.

4.15. **Removing Meters and Vaults.** Measured by each assembly removed and disposed of properly.

4.16. **Removing and Salvaging Water Meters.** Measured by each assembly removed and salvaged.

4.17. **Removing and Salvaging Fire Hydrants.** Measured by each assembly removed and salvaged.

4.18. **Removing and Relocating Water Meters and Meter Vaults.** Measured by each assembly removed and relocated.

4.19. **Adjusting Meter Vaults.** Measured by each assembly adjusted.

4.20. **Adjusting Meter Boxes.** Measured by each assembly adjusted.

4.21. **Adjust or Relocate Water Meter.** Measured by each assembly adjusted or relocated.

4.22. **Lowering Water Mains.** Measured by the foot, of the sizes and types of pipe lowered.

4.23. **Cutting and Plugging Water Mains.** Measured by each location a water main is cut and plugged, of the sizes indicated.

4.24. **Removing Pressure Reducing Stations.** Measured by each complete pressure reducing station removed.

4.25. **Wet Connections.** Measured by each connection, of the sizes specified.

4.26. **Extra Hand Excavation or Extra Machine Excavation.** Measured by the cubic yard in its original position. Excavation performed by manual labor at the locations specifically designated by the Engineer, and which is not included under or subsidiary to other bid items contained in this specification, is considered Extra Hand Excavation or Extra Machine Excavation.

4.27. **Adjusting Manholes.** Adjusted manholes will be measured as each manhole adjusted.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work described below. These prices are full compensation for furnishing, hauling, placing, and installing the materials; for inspecting and testing; and for other materials, labor, equipment, tools, and incidentals.

5.1. **Water Main Pipe and Steel Casing.** Payment for water main pipe, and steel casing will be made at the unit prices bid for "Water Main Pipe (Cast-Iron)," "Water Main Pipe (Steel)," "Water Main Pipe (Ductile Iron)," "Water Main Pipe (Copper)," "Water Main Pipe (Polyvinyl Chloride)(PVC)," and "Casing (Steel)," of the various sizes and types specified, installed by the open-cut method.

Unless otherwise shown on the plans or specifications, excavating, disposing of unsuitable excavated material, backfilling, and the material for backfill, for the complete installation of the water main system, are subsidiary to this bid Item.

5.2. **Split Steel Casing.** Payment for split steel casing will be made at the unit price bid for "Split Steel Casing," of the various sizes specified, installed by the open cut method.

5.3. **Fiberglass Reinforced Plastic (FRP) Pipe for Casing.** Payment for Fiberglass Reinforced Plastic (FRP) Pipe for Casing will be made at the unit price bit for "Fiberglass Reinforced Plastic (FRP) Pipe for Casing" of the various sizes specified.

5.4. **Jacking, Tunneling, Boring, or Augering.** Payment for jacking, tunneling, boring, or augering water main will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering (Water Main)," of the sizes and types specified. This price includes furnishing the pipe.

Payment for jacking, tunneling, boring, or augering fire hydrant branches (leads) will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering Fire Hydrant Branch (Lead)(6 in.)," of the types and installation method specified. This price includes furnishing the pipe.

Payment for jacking, tunneling, boring, or augering steel casing will be made at the unit price bid for "Jacking, Tunneling, Boring, or Augering Casing (Steel)," of the sizes, types, and wall thickness (applicable only if exceeding minimum thickness, shown in Section 2.2.2, "Steel Casing Pipe") specified. This price includes the casing. Water mains and fire hydrant branches (leads) placed in the casing will be paid for by the appropriate bid item.

Excavating, backfilling, backfill material, and disposing of unsuitable excavated material for jacking, tunneling, boring, or augering pits are subsidiary to these bid items.

5.5. **New Copper Service Lines.** Payment for copper service lines will be made at the unit price bid for "Service Line (Short Side 5/8 in. to 1 in.)," "Service Line (Long Side 5/8 in. to 1 in.)," "Service Line (Short Side 1-1/2 in. to 2 in.)" and "Service Line (Long Side 1-1/2 in. to 2 in.)," installed. This price is full compensation for labor, materials, excavation, and backfill required to install the facility, including connection to the customer's service line.

5.6. **Gate Valves, Tapping Sleeves and Valves, and Butterfly Valves.** Payment for gate valves (larger than 20 in. in diameter), tapping sleeves and valves, and butterfly valves will be made at the unit price bid for "Gate Valve," "Tapping Sleeve and Valve," and "Butterfly Valve," of the various sizes specified, with the valve box installed.

5.7. **Fire Hydrants.** Payment for fire hydrants will be made at the unit price bid for "Fire Hydrant Assembly," including 6 in. gate valve and box, installed regardless of barrel depth.

Payment for fire hydrant branches (leads) will be made at the unit price bid for "Fire Hydrant Branch (Lead) (6 in.)" installed by the open-cut method.

Any adjustment required either in the flow line of the water main or to the barrel length of the fire hydrant is subsidiary to this bid Item.

5.8. **Meters and Vaults.** Payment for meters and vaults will be made at the unit price bid for "Meter and Vault" constructed.

5.9. **Air Release and Vacuum Relief Valves.** Payment for air release and vacuum relief valves will be made at the unit price bid for "Air Release and Vacuum Relief Valve," of the various sizes specified, with the valve box installed.

5.10. **Pressure Reducing Stations.** Payment for pressure reducing stations will be made at the unit price bid for "Pressure Reducing Station." This price is full compensation for performing the necessary excavation, backfill, finish grading, constructing the concrete structure, and furnishing and installing station appurtenances addressed under Article 2, "Materials," of this specification.

5.11. **Blow Off Valves.** Payment for blow off valves with boxes will be made at the unit price bid for "Blow Off Valve" of the various sizes and types specified, with the valve box installed.

5.12. **Removing Fire Hydrants.** Payment for removing fire hydrants will be made at the unit price bid for "Removing Fire Hydrant." This price includes removing valves from the existing location, disposing of the valves, and plugging at the tee. Excavation and backfill required for removing fire hydrants are subsidiary to this bid Item.

5.13. **Removing Water Valves and Boxes.** Payment for removing water valves and boxes will be made at the unit price bid for "Removing Water Valve and Box." Excavation and backfill required for removing water valves and boxes are subsidiary to this bid Item.

5.14. **Removing and Relocating Meters and Boxes.** Payment for removing and relocating meters and boxes will be made at the unit price bid for "Removing and Relocating Meter and Box."

5.15. **Removing Meters and Vaults.** Payment for removing meters and vaults will be made at the unit price bid for "Removing Meter and Vault." This includes salvaging the meter strainers and valves and delivering them to their owner at the location shown on the plans or as directed.

5.16. **Removing and Salvaging Water Meters.** Payment for removing and salvaging water meters will be made at the unit price bid for "Removing and Salvaging Water Meter." This price includes removing salvaged water meters from the existing locations and delivering them to the owner. Excavation, backfill, and finish grading required for removing the water meters are subsidiary to this bid Item.

5.17. **Removing and Salvaging Fire Hydrants.** Payment for removing and salvaging fire hydrants will be made at the unit price bid for "Removing and Salvaging Fire Hydrant." The salvaging of fire hydrants will be a cash reimbursement to the owner by the Contractor where the fire hydrants will become the property of the Contractor or the Contractor will deliver the fire hydrants to the Utility Owner at the location shown on the plans. Excavation, backfill, and finish grading required for removing fire hydrants are subsidiary to this bid Item.

5.18. **Removing and Relocating Water Meters and Meter Vaults.** Payment for removing and relocating water meters and meter vaults will be made at the unit price for "Removing and Relocating Water Meter and Meter Vault."

5.19. **Adjusting Meter Vaults.** Payment for adjusting meter vaults will be made at the unit price bid for "Adjusting Meter Vault." This price is full compensation for furnishing the required materials, including backfill as required, excavation, tools, labor, equipment, and incidentals.

5.20. **Adjusting Meter Boxes.** Payment for adjusting meter boxes will be made at the unit price for "Adjusting Meter Box."

5.21. **Adjust or Relocate Water Meter.** Payment for adjusting or relocating water meters will be made at the unit price for "Adjusting or Relocating Water Meters." This price is full compensation for adjusting or relocating water meters. Miscellaneous fittings required to complete the work will not be paid for directly, but will be subsidiary to this Item unless otherwise shown on the plans. Water line sterilization and testing of the completed water main system is considered subsidiary to this Item.

5.22. **Lowering Water Mains.** Payment for lowering water mains will be made at the unit price bid for "Lowering Water Mains," of the sizes and types of pipe lowered. This price is full compensation for lowering and adjusting pipes, as well as any connected valves, boxes, and service lines. Excavation and backfill required for lowering water mains are subsidiary to this bid Item.

5.23. **Cutting and Plugging Water Mains.** Payment for cutting and plugging water mains will be made at the unit price bid for "Cut and Plug Water Main," of the sizes indicated. This price is full compensation for performing excavation, backfill, finish grading, and other incidental items required to abandon or cut and plug the water main as set forth this specification. Where grout is required, as shown on the plans, it is subsidiary to this bid Item.

5.24. **Removing Pressure Reducing Stations.** Payment for removing pressure reducing stations will be made at the unit price bid for "Removing Pressure Reducing Station." This price is full compensation for performing the necessary excavation, backfill, finish grading, pipe removal, structure removal, and for tools, equipment, and incidentals.

5.25. **Wet Connections.** Payment for wet connections will be made at the unit price bid for "Wet Connections," of the sizes specified.

5.26. **Extra Hand Excavation or Extra Machine Excavation.** Payment for extra hand excavation or extra machine excavation will be made at the unit price bid for "Extra Hand Excavation" or "Extra Machine Excavation." This price is full compensation for labor, hand tools, machines, dewatering, and handling and properly disposing of any excess excavated material not suitable for bedding or backfill for this project.

5.27. **Adjusting Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (Adj Exist Manhole)." This price is full compensation for replacement of Air Release / Vacuum Release Valve and installation of the Standard Bollards as shown on the plans; for materials including backfill as required, and for excavation, tools, equipment, labor, and incidentals.

Trench excavation protection or temporary special shoring for trenches greater than 5 ft. in depth, or sloping the sides of these trenches to preclude collapse, will be measured and paid for as required by Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring."

Furnishing and placing bedding material is subsidiary to the various bid items.

Providing fittings, including necessary concrete thrust blocking, pipe clamps, nipples, pipe coatings, and lubricants, etc. is subsidiary to the water mains in which they are installed.

In addition, providing fittings required due to plan changes or alterations in line and grade, is subsidiary to the water mains in which they are installed.

Furnishing and installing taps, risers, jumpers, blind flanges, cast-iron sleeves, plugs, reducers etc., as required to disinfect and pressure test the new mains is subsidiary to the various bid items. In addition, necessary excavation and backfill, site grading, and maintenance until completion of pressure testing are subsidiary to the various bid items.

Unless otherwise shown on the plans, the work performed and materials furnished to support the pipes or conduits of public utilities are subsidiary to the various bid items.

Furnishing and installing the nonmetallic pipe detection system, as well as the labor and materials necessary for the system, is subsidiary to the various bid items. In addition, ensure that the detection system is complete, operational, and satisfactory to the Utility Owner.

Adjusting valve boxes is subsidiary to the various bid items.

Special Specification 7040
Water Mains and Service Lines

1. DESCRIPTION

Provide and install a complete water main system in accordance with the plans and specifications and in compliance with the Department's Utility Accommodation Policy (UAP) (Title 43, T.A.C., Sections 21.31–21.55). The water mains will be of the sizes, materials and dimensions shown on the plans and must include all pipe, all joints and connections to new and existing pipes, all valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and other items required to complete the work.

The abbreviations AWWA, ASA, ASTM, and ANSI, as used in this Specification, refer to the following organizations or technical societies:

- AWWA – American Water Works Association
- ASA – American Standards Association
- ASTM – American Society for Testing and Materials
- ANSI – American National Standards Institute
- NSF – National Science Foundation

Where reference is made to Specifications of the above organizations, it is to be construed to mean the latest standard in effect on the date of the proposal.

1.1. **Buy America**. Comply with the latest provisions of Buy America pertaining to steel and iron in accordance with 23 CFR § 635.410. Use steel or iron materials manufactured in the United States except when waived in accordance with Section 6.1.2., “Buy America Expectations.”

Submit a notarized original FORM D-9-USA-1 (Department Form 1818) with the proper attachments for verification of compliance.

Manufacturing includes any process that modifies the chemical content, physical shape or size, or final finish of a product. The manufacturing process begins with initial melting and mixing and continues through fabrications (e.g., cutting, drilling, welding, and bending) and coating (e.g., paint, galvanizing, and epoxy).

2. MATERIALS

All materials used in this project are to be new and unused unless otherwise specified on the plans, Specifications, or the proposal. The Contractor must submit descriptive information and evidence that the materials and equipment the Contractor proposed for incorporation into the Work are of the kind and quality that meet the material requirements listed herein. The SAWS Material Specifications are part of this Specification and are available on the SAWS website at https://apps.saws.org/business_center/specs/matspecs/. In addition to the material specifications contractors may reference the SAWS Approved Products List. A link to the list is available on the SAWS website at https://www.saws.org/business-center/construction-material-specs/.Contractors may, when appropriate, use products that are specified in these Specifications or List; however, a Submittal is still required that clearly indicates the applicable SAWS Material Specification. The products listed in the SAWS Material Specifications must not be considered as a pre-approved list and cannot be substituted for items called out on the Drawings or on bid form.

2.1. **Ductile-Iron Pipe and Fittings**.

2.1.1. **Ductile-Iron Pipe: 3 in. through 64 in**. All ductile-iron pipes are to be manufactured by process of centrifugal casting and are to conform to ANSI/AWWA C151/A21.51.91, "American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids," or latest revision thereof, unless otherwise modified or supplemented herein.

Pipe is to conform to the following Table 1 pressure classes based on Type 3 bedding conditions, a bury depth of 6 ft., and a working pressure of 150 psi:

Table 1
Pipe Pressure Classes

Pipe Inside Diameter	Pressure
3"–2"	350 psi
16"–20"	250 psi
24"	200 psi
30"–64"	150 psi

Dimensions and tolerances for each nominal pipe size must be in accordance with Table 51.5 (push-on) or Table 51.5 (mechanical joint) of AWWA C-151 for pipe with a nominal laying length of 20 ft.

All pipes are to have standard water works interior cement mortar lining applied in accordance with ANSI/AWWA C-104/A21.4, latest revision. No asphaltic coating will be required on the interior cement mortar lining.

Exterior coating is to consist of a nominal 1-mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA C-151.

Rubber joint gaskets used on ductile-iron pipe are to conform to ANSI/AWWA C-111/A21.11, latest revision. Each length of pipe must bear identification markings in accordance with Section 51.10 of AWWA C-151.

Manufacturer is to take adequate measures during pipe production to assure compliance with AWWA C-151 by performing quality-control tests and maintaining results of those test as outlined in Section 51.14 of that standard.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe for testing by an independent laboratory for compliance with this Specification. Any visible defects or failure to meet quality standards herein will be grounds for rejecting the entire order.

Approved Manufacturers for Ductile Iron Pipe: Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.1.2. **Fittings for Ductile-Iron Pipe, PVC C-900**. This Section covers ductile-iron fittings 3 in. through 48 in. in size designed and manufactured for use with gray-iron, ductile-iron, PVC C-900 pipe. Standard, compact and anchor fittings included herein are of the following types of joints: Flanged and Mechanical Joint.

Unless otherwise modified or supplemented herein, the latest revision of AWWA C-110 for Gray-Iron and Ductile-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids and AWWA C-153 for Ductile-Iron Compact Fittings, will govern the design, manufacture, and testing of all fittings under this Specification.

For 3 in. through 24 in. size range, the pressure rating of all fittings is to be a minimum of 250 psi. The working pressure for all fittings of size greater than 24 in. is to be a minimum of 150 psi, unless a change in pressure rating is directed by purchase documents.

Fittings are to be furnished with the types of end combination specified. Flanged fittings are to be faced and drilled in accordance with ANSI Specification B 16.1, Class 125. Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings must be provided with a petroleum asphaltic coating in accordance with the latest revision of AWWA C110. The interior of flanged fittings supplied under this Specification must be either cement-mortar lined in accordance with the latest revision of AWWA C104 or lined with a petroleum asphaltic material in accordance with the latest revision of AWWA Standard as specified. The interior of all other fittings supplied under this Specification must be cement-mortar lined in accordance with the latest revision of AWWA C104.

Two-inch fittings are to be manufacturer's standard design in accordance with applicable design standards of AWWA C-110.

2.2. **Concrete Steel Cylinder Pipe and Fittings: 20 in. and larger**. This Section covers prestressed reinforced concrete water pipe with a steel cylinder and wire reinforcement in sizes 20 in. and larger.

Except as otherwise modified or supplemented herein, AWWA C301, "Prestressed Concrete Pressure Pipe—Steel Cylinder Type, for Water and Other Liquids" will govern the design, component materials, manufacture, and testing of all concrete-steel cylinder pipe furnished under this Specification.

Unless otherwise specified, all pipes must be AWWA Class 150 and must be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6 ft. of earth cover. Where the bury depth of the pipe is indicated to be greater than 6 ft. in the contract Specifications or on the drawings the design of the pipe must be suitable for the earth loads indicated.

All data submitted by the Contractor must include a tabulated layout schedule referencing the stationing and grade lines shown on the job plans. A design summary for each size of pipe furnished must be provided for each pressure and bury depth.

Each special and length of straight pipe must have plainly marked on the inside of the bell end the class of pipe and identification marks enough to show the proper location of the pipe by reference to layout drawings.

Pipe 20 in. through 42 in. in size must be furnished in nominal lengths of 20 ft. to 32 ft.; pipe 48 in. through 72 in. in size must be furnished in nominal lengths of 16 ft. except where modified by plan design requirements.

Each joint of pipe must be furnished with a rubber gasket and a 12 in. diaper.

2.3. **Steel Pipe, Fittings and Flanges**. This Section covers steel pipe 4 in. and larger in size and manufactured for the purpose of conveying water.

2.3.1. **Steel Pipe**. Steel pipe with nominal diameters from 4 in. through 20 in. must conform to ASTM A 106, A 53 Grade B or A 139 Grade B standard weight class as the minimum.

Steel Pipe greater than 20 in. must conform to AWWA C-200 and AWWA M-11 or as required by the Engineer for special circumstances.

Pipe must be designed for a minimum of 150 psi working pressure with an additional 50% of the working pressure allowance for surge pressure unless otherwise specified. Pipe design must be in accordance with AWWA M-11.

Pipe must be designed to cover conditions as shown on the plans. The design for deflection must be in accordance with AWWA M-11.

Use of an enhanced better soil backfill to limit deflection will be allowed with approval by the Engineer. (Criteria will be based on AWWA M-11).

Pipe for use with sleeve-type couplings must have plain ends at right angles to the axis.

Pipe joint length is to be up to 50 ft. net laying lengths except for special lengths, field trim pieces, and closure pieces as otherwise specified on the plans for location of elbows, tees, reducers, and other inline fittings. Manufacturer is to prepare a lay schedule showing the location of each piece by a mark number with station and invert elevation at each bell end.

2.3.2. **Fittings for Steel Pipe**. Unless otherwise shown on the plans, all specials and fittings must conform to the dimensions of AWWA C-208. Pipe material used in fittings must be of the same material and thickness as the pipe. The minimum radius of elbows must be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow must not exceed 11-1/4° (One cut elbow up to 22-1/2°). If elbow radius is less than 2.5 times pipe diameter, stresses must be checked per AWWA M-11 and wall thickness or yield strength increased if necessary. Fittings must be equal in pressure design strength. Specials and fittings, unless otherwise shown on the Plans, must be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe must be checked per the requirements of AWWA C- 200 Section 5.2.2.1.

2.3.3. **Joints**.

2.3.3.1. **Rolled-Groove Rubber Gasket Joint**. The standard joint must be rolled-groove rubber gasket joint unless otherwise noted on the plans. Rolled-grooved rubber gasket joints must conform to AWWA C-200 and as shown in Chapter 8 of AWWA M-11.

The O-ring rubber gasket must have enough volume to approximately fill the area of the groove and must conform to AWWA C-200.

The joint must be suitable for a safe working pressure equal to the class of pipe furnished and must operate satisfactorily with a deflection angle, the tangent of which is not to exceed 1.00/D where D is the outside diameter of the pipe in in. with a pull-out of 1 in.

Rolled-Groove Rubber Gasket Joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness that have been in successful service for a period of at least 5 yr.

2.3.3.2. **Lap Weld**. Lap field welded joints must be used where tied joints are indicated on the plans. The standard bell must provide for a 2-1/2 in. lap. The minimum lap must be 1 in. The design maximum joint deflection or offset must be a 1 in. joint pull.

2.3.3.3. **Mechanical Couplings**. Mechanical couplings, where indicated on the plans, must be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc or equal. Insulating mechanical couplings, where indicated on the plans, must be double insulated Smith Blair Style 416, Baker Style 216, or equal. Mechanical couplings must be rated to meet or exceed the working pressures and surge pressure of the pipe.

Couplings for buried service must have all metal parts painted with Epoxy paint and conform to AWWA C-219.

Pipe ends for mechanical couplings must conform to AWWA C-200 and M-11. The shop applied outside coating must be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings.

Harness lugs or rings and pipe ends must be painted with one shop coat of epoxy conforming to AWWA C-210. The inside lining must be continuous to the end of the pipe.

2.3.4. **Flanges, Gaskets, Bolts and Nuts**.

2.3.4.1. **Flanges**. Flanges must be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4 in. through 12 in. diameter, and operating pressures to 150 psi on diameters over 12 in.; or Flanges must be AWWA C207 Class E for operating pressures up to 275 psi; or Flanges must be AWWA C207 Class F for pressures to 300 psi. (drilling matches ANSI B 016.5 Class 250) Shop lining and coating must be continuous to the end of the pipe or back of the flange. Flange faces must be shop coated with a soluble rust preventive compound.

2.3.4.2. **Gaskets**. Full face, 1/8 in. thick, cloth inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

2.3.4.3. **Bolts and Nuts for Flanges**. Bolts for flanges located indoors and in enclosed vaults and structures must be carbon steel, ASTM A-307, Grade B for class B and D flanges and nuts must be ASTM A-563, Grade A heavy hex. Bolts for class E and F flanges must be ASTM A-193 grade B7 and nuts must be ASTM A-194, grade 2 H, heavy hex.

2.3.4.4. **Bolts**. Bolts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures must be Type 316 stainless steel conforming to ASTM A-193, Grade B8M, Class 1 for class B and D Flanges with ASTM A-194, Grade 8M nuts. For Class E and F flanges the bolts must be ASTM A-194 grade-2H nuts with bolt and nuts to be zinc plated in accordance with ASTM B-633.

2.3.5. **Linings and Coatings**.

2.3.5.1. **Polyethylene Tape Coating**. Prefabricated Multi-layer Cold Applied Tape Coating - the coating system for straight-line pipe must be in accordance with AWWA C-214. The system must consist of three layers of polyethylene material with a nominal thickness of 80 mils when complete.

2.3.5.2. **Coating Repair**. Coating repair must be made using tape and primer conforming to AWWA C-209, Type II. The tape and primer must be compatible with the tape system used for straight-line pipe.

2.3.5.3. **Coating of Fittings, Specials and Joints**.

2.3.5.3.1. **General**. Fittings, specials, and joints which cannot be machine coated in accordance with above, must be coated in accordance with AWWA C-209. Prefabricated tape must be Type II and must be compatible with the tape system used for straight-line pipe. The system must consist of three layers consisting of the following: Alternate coating methods for fittings specials and field joints would be Shrink sleeves per C-216, or paint per C-210, C-218, or C-222. The field coating must completely encapsulate the joint bonds on O-ring joints.

2.3.5.3.2. **Coating Repair**. Coating repair for fittings and specials must be in accordance with the procedure described above for straight-line pipe and as recommended by the manufacturer.

2.3.5.4. **Other Coating Systems**. If specified must be governed by the appropriate American Water Works Association standard.

2.3.5.5. **Cement Mortar per AWWA C-205**.

2.3.5.5.1. **Cement Mortar Lining of Steel Pipe**. Except as otherwise provided in AWWA C-205, interior surface of all steel pipes, fittings, and specials must be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C-205.

The pipe ends must be left bare where field joints occur as shown on the Plans. Ends of the linings must be left square and uniform. Feathered or uneven edges will not be permitted.

Defective linings as identified in AWWA C-205 must be removed from the pipe wall and must be replaced to the full thickness required. Defective linings must be cut back to a square shoulder to avoid feather edged joints.

Cement mortar lining must be kept moist during storage and shipping.

2.3.5.5.2. **Fittings**.

Fittings must be lined and coated per AWWA C-205.

2.3.6. **Steel Casing Pipe**. Steel casing pipe must conform to ASTM A134 with a minimum thickness of 3/8 in.; actual thickness will be as indicated on the plans.

2.3.7. **Quality Assurance**. Commercial Standards (All manufacturing tolerances referenced in the below standards apply unless specifically excluded).

- ANSI/AWWA C-200 Standard for Steel Water Pipe 6 in. and Larger.
- ANSI/AWWA C-205 Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 in. and Larger-Shop Applied.
- ANSI/AWWA C-206 Standard for Field Welding of Steel Water Pipe.
- ANSI/AWWA C-207 Standard for Steel Pipe Flanges for Water Works Service, 4 in.–144 in.
- ANSI/AWWA C-208 Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- ANSI/AWWA C-209 Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-210 Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- ANSI/AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.
- ANSI/AWWA C-216 Standard for Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-218 Standard for Liquid Coating the Exterior of Aboveground Steel Water Pipelines and Fittings.
- ANSI/AWWA C-219 Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.
- ANSI/AWWA C-222 Standard for Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings.
- AWWA M-11 Steel Pipe - A guide for Design and Installation.
- ASTM A-106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- ASTM A-53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- ASTM E-165 Method for Liquid Penetrant Examination.
- ASTM E-709 Guide for Magnetic Particle Examination.
- ASME Section V Nondestructive Testing Examination.
- ASME Section IX Welding and Brazing Qualification.
- AWS B2.1 Standard for Welding Procedure and Welding Qualifications.

2.3.8. **Qualifications**. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished must furnish all Steel pipe and fittings. The pipe and fittings must be designed, constructed, and installed in accordance with the best practices and methods and must comply with these Specifications as applicable.

Pipe must be the product of one manufacturer that has not less than 5 yr. successful experience manufacturing pipe in the United States of the particular type and size indicated. All pipe manufacturing including cylinder production, lining, coating, and fittings must be produced by one manufacturer. The pipe manufacturer must have a certified quality assurance program. This certified program must be ISO 9001:2000 or other equivalent nationally recognized program.

2.3.9. **High Density Polyethylene Pipe**. The materials for High Density Polyethylene Pipe (HDPE) and HDPE tubing for Water Supply Lines should conform to the following requirements:

HDPE pipe with 4" to 65" diameter should be PE4710 solid wall pipe and fittings that are in conformance with ASTM F714, AWWA C901 and C906, and NSF 61 requirements stated herein. Pipe 6-inch and larger diameter should be a minimum of DR 11 (pressure rating of 200 psi) and Ductile Iron Pipe Size (DIPs) outside diameter.

Pipe and Fitting Manufacture: All pipe and fittings will be high density polyethylene pipe and made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation will be used. The pipe and fitting produced from this resin will have a minimum cell Classification of 445574 C under ASTM D3350. For potable water applications, the cell classification should be 445574C-CC3. The value for the Hydrostatic Design basis will not be less than 1,600 psi at 73°F per ASTM D2837. Pipe will have ultraviolet protection for a minimum of three (3) years. The hydrostatic design stress (HDS) rating for water at 73°F should not be less than 1,000 psi that should be listed in PPI TR-4 in the name of the pipe manufacturer.

Pipe and Fitting Quality: All pipes and fittings should be free of visible cracks, holes, foreign material, foreign inclusions, blisters, or other deleterious or injurious faults or defects. Pipe and fittings should be as uniform as commercially practical in color, opacity, density, and other physical properties. Cuts or gouges, per AWWA M55 are acceptable up to 10% of wall thickness. Cuts or gouges in excess of 10% of wall thickness must be removed by cutting the damaged section from the pipe string and butt fusing the ends.

Pipe Marking: Each length of pipe should be clearly marked with pipe manufacturer, pipe size, pipe class, production code, material designation and other relevant identifying information. Stripe along the length of pipe should be blue in color to identify the pipe as potable water. Stripe should be extruded in the pipe every 120° – painted on stripes are not acceptable.

Fittings: When butt fusion is not possible, polyethylene pipe should be connected by electrofusion coupling. Electrofusion couplings should be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in section 815.4. Electrofusion Fittings should be manufactured in accordance with ASTM F1055. All electrofusion fittings should be suitable for use as pressure conduits and should be pressure rated equal to the pressure rating of the pipe to which it is joined. Markings should be according to ASTM F1055. Acceptable manufacturers are included in SAWS' Approved Products List (APL). Polyethylene pipe and mechanical fittings should be connected by means of a polyethylene flange adapter or polyethylene mechanical joint adapter with backup ring.

The polyethylene adapter should meet the same material requirements as the HDPE pipe. Approved manufacturers for mechanical or flanged joint adapters are included in SAWS' APL. Provide MJ adapters with kit, manufactured in accordance with ASTM D3261. The adapter kit should include the following: Rubber gasket, MJ backup ring, Corrosion resistant – Cor Blue bolts and nuts. Provide flanged adapters with kit, manufactured in accordance with ASTM D3261. The adapter kit should include the following: Metallic back-up rings (Van-Stone style lap joint flanges) should have a radius on the inside diameter of the bore so as to be compatible with HDPE flanges. Back up ring should have a bolt pattern that will mate with AWWA C207 Class D (or B or E), ASME/ANSI B 16.5 Class 50, ASME/ANSI B 16.1 Class 125, or ASME/ANSI B16.47 Series A. Flange adapters should meet the dimensional and material requirements of ASTM F2880. Mechanical fittings should meet Specification section 2.1 "Ductile-Iron Pipe and Fittings" except as modified herein. Pipe connection fittings should be meet or exceed the pressure requirements of the HDPE pipe and should be certified by the fitting manufacturer as suitable for use with HDPE pipe. Stiffener inserts should be used for all fittings and connections to HDPE pipe unless specifically not recommended by the fitting and pipe manufacturers. Stiffeners should be 304 stainless steel. Stiffener should be wedge type design or solid design as recommended by fitting manufacturer for the size of pipe. Mechanical fittings that do not provide restraint against pull-out or pushoff are prohibited. Flange adapters for connection to butterfly valves should be factory beveled to permit clearance of butterfly valve disc. Bevel should not result in pressure rating less than requirements of the pipe to be connected to.

Flex restraints or integral pipe collars for restraint should be designed by the pipe or fitting manufacturer and suitable for fusing to the HDPE pipe. The size and number of the flex restraints or size of the pipe collar (width and diameter) should be as designed by the manufacturer to accommodate the loads indicated in the plans.

HDPE tubing 3-inch and smaller should be HDPE conforming to the latest edition of ANSI/AWWA C901 and ANSI/NSF Standard 61. HDPE tubing should be copper tube size (CTS), DR.9 Mechanical fittings for service HDPE tubing should be compression type. Stainless steel inserts should be used at connections to brass fittings as recommended by the fitting manufacturer. Splicing of the HDPE tubing should not be allowed. HDPE tubing color should be blue or black with a blue stripe.

HDPE tubing Marking: HDPE tubing should be marked in accordance with the standards to which it is manufactured. Include nominal size, DR, manufacturer's name or trademarks, materials designation code, date of manufacturer, pressure rating, and mark of certifying agency (ASTM and NSF).

Service connection fittings to distribution or transmission main should be mechanical saddles and should meet SAWS' Material Specifications 110-30 "Service Saddles" except as modified herein. Saddles should be designed for use on HDPE piping to maintain a pressurized seal with the HDPE main regardless of change in pipe diameter due to temperature or pressure and should be engineered to prevent sliding or rotation movement.

Clamps and Gaskets: Clamps should be stainless steel and should meet the requirements SAWS' Material Specifications 100-32 "Standard/Wide Range Repair and Tap Clamps". Furnish full circle, universal clamp couplings with a minimum 3/16-inch-thick neoprene, grid-type gasket. Select clamps to fit outside diameter of pipe. Use minimum clamp length of 30 inches for replacement pipes O.D. of 10.75 inches (10inch nominal) or greater and 18 inches for replacement pipe O.D. less than 10.75 inches.

Tracer wire should be utilized for location and taped directly to the pipe. Tracer wire should be properly spliced at each end connection and each service connection. Tracer wire should be adequately wrapped and protected at each splice location in accordance with manufacturer recommendations. No bare tracer wire should be accepted. Wire should also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector. Tracer wire should be utilized for location purposes and taped directly to the top of pipe. Tracer wire should be of solid core (14 gauge insulated), and should be taped to the main in minimum of 10 inch increments.

Detection Tape should not be used in-lieu of tracer wire. Detection Tape – Detection Tape should be 12 inches wide with repeating black lettering as follows "BURIED POTABLE WATER LINE BELOW". Lettering should be a minimum of 1-inch; aluminum foil core; 0.5 mil thick; encased in a protective inert plastic jacket; 5,000 psi minimum tensile strength; 2.5 lb./inch per 1,000 feet minimum weight, colored blue. Detection Tape should be installed once backfill has been placed and compacted to at least 12 inches above the top of pipe and not more than 18 inches above the top of pipe.

2.3.10. **Split Steel Casing Pipe**. Steel casing pipe must conform to ASTM A134 with a minimum thickness of 3/8 in.; actual thickness will be as shown on the plans.

Ensure each section is split in half sections. Pipe ends and split sections will be beveled and suitable for field butt welding.

2.4. **Polyvinyl Chloride Pipe and Fittings**.

2.4.1. **Polyvinyl Chloride Pipe, 4 in. through 12 in. (C-900)**. This Section covers 4 in. through 16 in. diameter polyvinyl chloride (PVC) pressure pipe made from class 1245A or 1245B compounds as determined by ASTM D1784 and providing for a hydrostatic test basis (HDB) of 4,000 psi. All pipe furnished must be in accordance with AWWA C900, or latest revision thereof.

Except as noted on the plans or procurement Specifications for specific jobs, all PVC C900 pipe must be (DR 18) with a sustained pressure requirement of 500 psi and a minimum burst pressure of 755 psi (ASTM D1599). Pipe pressure class must be written on the pipe and as per most current applicable AWWA standards. PVC pipe greater than 16" is not allowed.

Dimensions and tolerances for each nominal pipe sizes must be in accordance with Section 2.2, Table 1 of AWWA C900.

Pipe must be furnished in standard laying lengths of 20 ft. (±1 in.) unless otherwise noted. Each pipe must have an integral bell formed on the pipe end, and be designed to be at least as strong as the pipe wall (ASTM D2472).

An elastomeric gasket must be designed with a retainer ring, which "locks" the gasket into integral bell groove and must be installed at the point of manufacture. Gasket must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings in accordance with Section 2.6 of AWWA C900.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundles (units) must be packaged to provide structural support to ensure that the weight of upper units must not cause deformation to pipe in lower units. No pipes bundles will be accepted which show evidence of ultraviolet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions.

The manufacturer must take adequate measures during pipe production to assure compliance with

AWWA C900 by performing quality-control tests and maintaining results of those tests as outlined in Section 3 of that standard. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 to 50 yr.

Inductive Tracer Detection Tape must be placed directly above the centerline of all non-metallic pipe a minimum of 12 in. below subgrade or, in areas outside the limits of pavement, a minimum of 18 in. below finished grade to aid locating pipe in the future. Detection tape should be 12 inches wide with repeating black lettering as follows "BURIED POTABLE WATER LINE BELOW". Lettering should be a minimum of 1-inch; aluminum foil core with 0.35 mil minimum thickness; 0.5 mil total thickness; 5,000 psi minimum tensile strength; 2.3 lb./inch per 1,000 feet minimum weight, colored blue. The tracer tape must be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed according to manufacturer's recommendations.

A 1 yr. warranty must be provided for all materials sold and delivered for use and incorporated into the San Antonio water distribution system. Such warranty will take effect on the date that the pipe is received and accepted by an authorized representative of the San Antonio Water System.

User references and a claims history must be provided for further investigation, before rending a final decision on the acceptance of the product to be furnished.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

Approved Manufacturers for PVC C-900 Pipe: Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.4.2. **Polyvinyl Chloride Pipe, 4 in. through 16 in. (C-909)**. This Section covers molecularly oriented 4 in. through 16 in. diameter Polyvinyl Chloride (PVC) pressure pipe manufactured from starting stock pipe made as determined by ASTM DI784. The starting stock materials are then oriented through circumferential expansion to provide a hydrostatic design basis of 7,100 psi. Pipe must be homogenous throughout. It must be free from voids, cracks, inclusions, and other defects. It must be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces must be free from nicks and scratches. Joining surfaces of spigots and joints must be free from gouges and imperfections that could cause leakage. All pipe furnished must be in accordance with AWWA C-909-02, or latest revision thereof and meet the ANSI/NSF 61 requirements. Inductive Tracer Detection Tape must be placed directly above the centerline of all non-metallic pipe a minimum of 12 in. below subgrade or, in areas outside the limits of pavement, a minimum of 18 in. below finished grade to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Detection tape should be 12 inches wide with repeating black lettering as follows “BURIED POTABLE WATER LINE BELOW”. Lettering should be a minimum of 1-inch; aluminum foil core with 0.35 mil minimum thickness; 0.5 mil total thickness; 5,000 psi minimum tensile strength; 2.3 lb./inch per 1,000 feet minimum weight, colored blue. Except for minimum depth of cover, the tracer tape must be placed according to manufacturer’s recommendations.

2.4.2.1. **General Requirements**. Except as noted on the plans or procurement Specifications for specific jobs, all PVC C-909 pipe must be Class 235 with a sustained pressure requirement of 500 psi (ASTM D2241) and a minimum burst pressure of 755 psi (ASTM D1599.)

Dimensions and tolerances for each nominal pipe size must be in accordance with Section 4.3 “Pipe Requirements,” Table 1 of AWWA C-909.

Pipe must be furnished in standard lengths of 20 ft. (± 1 in.) unless otherwise noted. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket that “locks” into the integral bell groove must be installed at the point of manufacture. The gasket must be in accordance with ASTM F477.

Each length of pipe furnished must bear identification markings in accordance with Section 6.1.2, “Pipe” of AWWA C-909.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundle units must be packaged to provide structural support to ensure that the weight of upper units will not cause deformation to pipe in the lower units.

No pipe bundles will be accepted which show evidence of ultraviolet radiation “sunburn” on exposed pipe as may be caused from extended unprotected storage conditions.

The manufacturer must take adequate measures during pipe production to assure compliance with AWWA C-909 by performing quality-control tests and maintaining results of those tests as outlined in Section 5.2 Quality-Control Records of that standard. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe is received and accepted by an authorized representative of the San Antonio Water System.

A 1 yr. warranty must be provided for all materials sold and delivered or use and incorporated into the San Antonio water system. Such warranty will take effect on the date that the pipe is received and accepted by an authorized representative of the San Antonio Water System.

User references and a claims history must be provided for further investigation before rendering a final decision on the acceptance of the product to be furnished.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.4.2.2. **References**.

- ANSI/AWWA C-909; AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. through 16 In. for Water Distribution.
- ASTM D 1598; Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
- ASTM D 1599; Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
- ASTM D 1784; Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- ASTM D 2122; Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- ASTM D 2152; Test Method for Degree of Fusion of Extruded Poly Vinyl Chloride (PVC) Pipe and Molded Fittings by Acetone Immersion.
- ASTM D 2241; Specification for Polyvinyl Chloride (PVC) Pressure Rated Pipe (SDR Series).
- ASTM D 2412; Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- ASTM D 2837; Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- ASTM D 3139; Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- ASTM F 477; Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- ANSI/NSF 61; Drinking Water System Components – Health Effects.
- PPI TR3; Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

2.4.2.3. **Manufacturers**. Approved Manufacturer for PVC C-909 Pipe: Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.5. **Joint Restraint System**. This Section covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4 in. through 16 in. diameter, and for Ductile Iron pipe sizes from 4 in. through 24 in. diameter. Joint restraint systems are classified as “compression,” “mechanical joint,” or “non-metallic restrained joint” for the specific type of pipe joint to be restrained.

2.5.1. **General Requirements**. Underwriter Laboratories (UL) and Factory Mutual (FM) certifications are required on all restraint systems.

Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe must meet or exceed ASTM F1674-96, “Standard Test Methods for Joint Restraint Products for Use with PVC Pipe,” or the latest revision thereof. Restraint systems used on ductile pipe must meet or exceed U.L. 194.

Non-metallic restrained joint pipe and couplings must be used specifically for PVC C-900 pipe and fittings in sizes 4 in. through 12 in.

Each restraint system must be packaged individually and include installation instructions.

2.5.2. **Specific Requirements**.

2.5.2.1. **Restrainer for PVC C-900 & Ductile Iron Push-on Type Connections**. Pipe restraints must be used to prevent movement for push-on D.I. or PVC (C-900) (compression type) bell and spigot pipe connections or where a transition or flexible coupling has been used to join two sections of plain-end pipe D.I. or PVC (C-900). The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.

The pipe must be restrained by a split retainer band. The band must be cast ductile iron, meeting or exceeding ASTM A-536-80, Grade 65-45-12. The inside face or contact surface of the band must be of enough width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration must provide full (360°) contact and maintain pipe roundness and avoid any localized points of stress. The split band casting must be designed to “bottom-out” before clamping bolt forces (110-ft. lb. minimum torque) can over-stress the pipe, but will provide full non-directionally sensitive restraint at the rated pressures.

Bolts and nuts used to attach the split retainer ring must comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts and restraining rods must be fabricated from high-strength, low-alloy steel per AWWA C-111-90.

The split ring type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2 and be for both D.I. and PVC C-900.

Restraint systems sizes 6 in. through 12 in. must be capable of use for both ductile iron and PVC C-900.

The restraint system may consist of two types: the two split retainer rings and for new construction use only the one split and one solid cast backup ring.

2.5.2.2. **Compression Ring Fitting Restrainer for Ductile Iron Pipe & PVC C-900**. Compression ring with follower gland type of restrainer may be used in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

The system must use a Standard MJ gasket with a color-coded compression ring and replacement gland conforming to ASTM A-536-80, Grade 65-45-12.

Standard MJ fitting Tee-bolts and nuts must be fabricated from high strength steel conforming to ANSI AWWA C-111/A-21.11 and AWWA C-153/A-21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

The restraint system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2.

2.5.2.3. **Non-metallic Restrained Joint Pipe and Couplings for PVC C-900 Type Connections**. Gasketed restrained coupling connections must join two sections of factory grooved PVC C-900 pipe. The restrainer coupling must not be directionally sensitive.

The coupling must incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and must be DR-18 Class 235 PVC C-900 in all applications, meeting or exceeding the performance requirements of AWWA C-900, latest revision. The inside face or contact surface of the coupling connection must be of enough width to incorporate a factory machined non-directionally sensitive groove in both pipe and coupling to grip the outside circumference of the pipe. The couplings must provide full (360°) contact and maintain pipe roundness and avoid and localized points of stress. The coupling must be designed with an internal stop to align the precision-machined grooves in the coupling and pipe before installation of a non-metallic thermoplastic restraint spleen, and will provide full non-directionally sensitive restraint at the rated pressures.

High-strength flexible thermoplastic spleens must be inserted into mating precision–machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

The non-metallic restrained joint pipe and couplings for PVC C-900 type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2 and be for PVC C-900 pipe sizes 4 in. through 12 in.

Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes 4 in. through 12 in. must be capable of use for Class 235 (DR 18).

The non-metallic restrained joint pipe and couplings for PVC C-900 restraint system must consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of Factory Mutual (FM) and Underwriters Lab (UL).

2.5.2.4. **Fitting Restraint for Ductile Iron Pipe (only)**. Radial bolt type restrainer systems must be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system must use a Standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions must conform to Standard MJ bolt circle criteria.

Individual wedge restrainers must be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

Standard MJ fitting Tee-bolts and nuts must be high strength steel conforming to AWWA C111/A21.11 and C153/A21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

2.5.3. **Maximum Sustained Working Pressure Requirement**.

Table 2
Max Sustained Working Pressure Requirement

Nominal Diameter	PVC C-900	Ductile Iron
4 in. & 6 in.	200 psi	350 psi
8 in.	200 psi	250 psi
10 in. & 12 in.	200 psi	200 psi
14 in. & 16 in.	200 psi (C-900) / 235 psi (C-905)	200 psi

2.5.3.1. **Tests**. The San Antonio Water System may, at no cost to the Contractor, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

2.5.3.2. **Manufacturers**. Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.6. **Stainless Steel Casing Spacer/Insulators**. This Section covers casing spacers for use in water supply service. Casing spacers are used to facilitate installing a water pipe inside a casing pipe or tunnel. Casing spacers must consist of two or more segments of circular steel that bolt together forming a shell around the carrier pipes. Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipes within the casing or tunnel. On occasion multiple carrier pipes may be installed in one casing or tunnel.

2.6.1. **General Requirements**. The San Antonio Water System (SAWS) reserves the right to limit the purchase of casing spacers from the manufacturers and to the models specified as shown on the SAWS website - https://www.saws.org/business-center/construction-material-specs/, providing such casing spacers conform to the provisions contained herein.

Casing spacers must be 8 in. long for carrier pipes up to 16 in. diameters and 12 in. long for larger carrier pipe sizes. Manufacturer's approval in writing will be required for installations exceeding 300 ft. in length, carrier pipes in excess of 48 in. diameter or multiple carrier pipes in one casing or tunnel.

Casing spacers must have a minimum 14-gauge steel band and 10-gauge steel riser when required. The band, risers and connecting studs must be welded and cleaned at the factory before the application of a fluidized bed fusion bonded PVC coating. Stainless steel (type 304) casing spacer is an acceptable alternative.

The fluidized bed fusion bonded PVC coating must be between 10-16 mils thickness. The PVC coating must provide good resistance to acids and alkalize and excellent resistance under ASTM B117 salt spray tests. The coating must have a minimum 1380 volts/mil per ASTM D149-61 short time 0.010 in. test and a Durometer-shore A @ (10 sec) of 80 per ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.

The spacers must have a flexible PVC liner of 0.09 in. thickness with Durometer "A" 85-90 hardness and a minimum 58,000-volt dielectric strength (60,000-volt minimum Surge Test.) Moisture absorption must not exceed 1%.

The runners must be of high pressure molded glass reinforced polyester with a minimum compressive strength of 18,000 psi per ASTM D695, flexural strength of 25, 300 psi per ASTM D790, tensile strength of 17,600 psi per ASTM D638 and Rockwell hardness (M) of 90 per ASTM D785. The riser must be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This evenly distributes the load force to all support members. The ends of all runners must be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners must be a minimum of 1 in. in width and a minimum of 7 in. long for carrier pipes up to 16 in., and a minimum of 2 in. in width and 11 in. long for larger carrier pipes. Bolts on runners are not acceptable. The runners must be attached to the band or riser by 3/8 the wearing surface on the runner. The recess must be filled with a corrosion inhibiting filler. There must be four runners per casing spacer for carrier pipes up to 12 in. diameter, six runners for 14 in. through 36 in. and eight or more runners for carrier pipes over 36 in. diameter.

Number of bottom runners must be multiples of two. Number of top runners must be multiples of two.

The band section must be bolted together with 5/16 in. cadmium-plated studs, nuts, and washers. There must be six sets per 8 in. long casing spacer and eight sets per 12 in. long spacer. Stainless steel casing spacers must be furnished with stainless steel studs, nuts, and washers.

Casing spacers must have ample riser height to limit vertical movement of the carrier pipe in the casing. A minimum of 1 in. to 2 in. clearance must be provided between the top runner and the ID of the casing or tunnel.

Continuous operating temperatures for the PVC Coated Casing Spacers should not exceed 150°F. Stainless steel casing must be used in applications where continuous operating temperatures exceed 150°F.

Unless noted otherwise, casing spacers and end seals will be required on all carrier pipes installed in casing or tunnel applications.

2.6.2. **Quality Assurance**. All casing spacers are to be manufactured in accordance with NACE International Recommend Practice RP 0286-97 (Isolation Spacers.) Each casing spacer must be manufactured in the USA at a facility that has a Registered ISO 9002 Quality Management System or be in the process of achieving this certification by March 2005. Non-compliance to this registered commercial quality system requirement by March 2005 will result in removal of the manufacturer's product from the approved manufacturers.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer must replace the defective casing spacer with a casing spacer that meets the San Antonio Water System's Specifications, at no charge to San Antonio Water System.

If San Antonio Water System audits, product inspection and performance data review in accordance with these Specifications determine excessive casing spacer Non-compliance, the manufacturer will be subject to removal by the Products Standard Committee. Copy of the current ISO 9002 registration (or written documentation of being "in the process of achieving ISO registration," before March 2005) must be provided with material submittal.

2.7. **Copper Tubing and Brass Fittings for Copper Service Lines**.

2.7.1. **Copper Tubing**. This Section covers copper tubing in nominal sizes of 3/4 in., 1 in., 1-1/2 in., and 2 in.

2.7.1.1. **General Requirements**. Copper tubing must be of the type commercially known as Type "K" soft and conforms to NSF 61, ASTM Specifications B-88, or latest revision thereof.

3/4 in. and 1 in. copper tubing must be furnished in 60 ft. coils or 100 ft. coils as specified; 1-1/2 in. must be furnished in 20 ft. lengths, 40 ft. coils or 60 ft. coils as specified, and 2 in. must be furnished in 20 ft. lengths or 40 ft. coils as specified.

Copper tubing is the only allowable material for small service lines.

PEXa Tubing Section specifications under review. To be added when complete.

2.7.2. **Brass Fittings**. This Section covers waterworks brass goods, such as corporation stops, curb stops, couplings, connectors, nipples, etc.

2.7.2.1. **General Requirements**. The brass composition must conform to ASTM Specifications B-62, or latest revision thereof, fittings must conform to ANSI/AWWA Specifications C-800, or latest revision thereof.

All brass components in contact with potable water must be "lead free" and marked by stamping, etching, or casting "NL" in the main body made from either CDA/UNS Brass Alloys C89520 in accordance with

ASTM B584; or C89833. Brass saddles must be made from CDA/UNS C83600.

Any brass component not in contact with potable water must be made of 85-5-5-5 brass as defined per ASTM B62, ASTM B584 and AWWA C-800.

All service fittings must be certified as suitable for contact with drinking water by an ANSI accredited organization in accordance with ANSI/NSF 61, Drinking Water Systems Components-Health affects Section 8. Proof of certification is required. The lead content of the wetted components in contact with potable water must also be verified by an ANSI accredited testing facility.

All brass fittings and valves must have the manufacturers name or trademark integrally stamped, or cast into it indicating that the product is manufactured from the low-lead alloy as specified. Another marking such as "NL," "EBII," "FD" or other commonly accepted identifier, indicating the alloy as "No-lead"; must also be cast or stamped into the fitting or valve.

Painting, printing, sticker, or decals attesting to the components "no-lead" certification will not be permitted. All casting must have a natural, clean uniform and smooth surface, and be free from internal porosity.

All machining must be done in a workmanlike manner and within the acceptable tolerances.

2.7.2.2. **Design Criteria for Ball Type Curb Stops/Angle Valves**. All Curb Stop, Corporation and Angle valves must be ball valves. "Inverted/Ground Key" type angle valves will not be accepted.

Ball type valves will not have a stop.

All ball valves, couplings and adapters will be pressure rated to 300 psi, and will be supplied with blowout proof stainless steel stems with double SBR, NBR or EPDM O-ring steam seal.

Stem and cap assembly will be two-piece design and will withstand minimum 200-ft. lb. of torque. Ball seats will be made with unfilled Teflon or EPDM for resilience and minimal friction.

Ball will be lead free cast brass or stainless design. Coated ball is not permitted. All fittings must have a lifetime guarantee against lead leachate from the casting. The reduced port design will not be acceptable.

Pack Joints will not be accepted.

2.8. **Gate Valves, Tapping Valves and Tapping Sleeves**.

2.8.1. **Resilient-Seated Gate and Tapping Valves ANSI/AWWA C509-01**. This product Specification covers resilient seated gate valves, with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., 12 in., 16 in., and 20 in. Sizes refer to the nominal diameter, in in., of the waterway through the inlet and outlet connections and the closure area. All products furnished must conform to the ANSI/AWWA C-509-01, or latest revision thereof.

2.8.1.1. **Definitions**. All definitions are defined according to ANSI/AWWA C509-01.

2.8.1.1.1. **Cosmetic Defect**. A blemish, which has no effect on the ability of the component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, then the blemish will be considered a structural defect.

2.8.1.1.2. **Flanged Joint**. The flanged and bolted joint as described in ANSI/AWWA C110/A21.10.

2.8.1.1.3. **Mechanical Joint**. The gasket and bolted joint as described in ANSI/AWWA C111/A21.11.

2.8.1.1.4. **Push-on Joint**. The single rubber gasket joint as described in ANSI/AWWA C111/A21.11.

2.8.1.1.5. **Structural Defect**. A flaw that causes the component to fail the structural design or test requirement of this standard. This includes, but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall-thickness requirement, or failure to meet production tests.

2.8.1.1.6. **Tapping Valve**. A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure as described in AWWA C-509 Section 1.2, "Definitions" and MSS SP-60.

2.8.1.2. **General Requirements**. Except as otherwise modified or supplemented herein, AWWA C-509-01 or the latest revision thereof, will govern the design, component materials, construction; manufacture and testing of all resilient seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The San Antonio Water System reserves the right to limit the purchase of resilient seat gate valves from manufacturers and to the models specified, provided such resilient seat gate valves conform to the provision contained herein. Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

The minimum design working water pressure for gate valves with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., and 12 in. must be 200 psig unless otherwise specified.

The minimum design working water pressure for gate valves with nominal diameters of 16 in., 20 in., and 24 in. must be 150 psig unless otherwise specified.

Valves must be resilient-seated types, bronze mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open the valve must have a clear, full-port, unobstructed waterway.

Gray iron, ductile iron, steel, brass, and bronze materials must meet or exceed the material requirements of Section 2, “Materials” of AWWA C-509-01.

Gaskets, O-rings, Coatings, and elastomers must meet or exceed the material requirements of Section 2, “Materials” of AWWA C-509-01.

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves must be designed for buried installation with stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM recognized alloy Specifications of low zinc content bronze, as shown in Table 1 of Section 2.2.4. of ANSI/AWWA C-509-01, or the latest revision thereof. Materials for the stem have minimum yield strength of 40,000 psi. A minimum elongation in 2 in. of 12% and must be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material must be ASTM B-62 UNS C83600 or ASTM B-584 UNS C84400. The stem must have a visible external marking at the top to indicate low-zinc, high strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements of ASTM A-307 with dimensions conforming to ANSI B18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of either gray or ductile iron: bonnet, body, yoke, wrench nut, O-ring packing plate or seal plate, and gland follower. The gate may be made of gray or ductile iron.

If glands and bushings are used for NRS valves they must be made of ASTM B-763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B-763 bronze UNS C99500. The stem nut material must be ASTM B-62 bronze UNS C83600 or ASTM B-584 bronze UNS C84400. The gate may be made of bronze ASTM B-763 bronze UNS C99500. Stem seals must be “O” ring type. The seals must be designed for dynamic applications.

The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the “O” ring packing plate must be in accordance with Section 4.8.3 of ANSI/AWWA C509-01 or the latest revision thereof.

Enclosed and buried valves must be coated inside and outside with a fusion bonded epoxy with a nominal 8 mils dry film thickness, which meets or exceeds AWWA C-550-01 and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service per ANSI/NSF 61.

The bidder must submit with his proposal three sets of certified drawings showing the principal dimensions, general construction and material Specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this Specification must be supplied from the San Antonio Water System approved manufacturer list shown on the SAWS website - https://www.saws.org/business-center/construction-material-specs/. To be included on the qualified product list, the manufacturer must provide an Affidavit of Compliance in accordance with the Section 1.5 of ANSI/AWWA C-509-01 or latest revision thereof, to include compliance with San Antonio Water System Specification No. 21-02. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of ANSI/AWWA C-509- 01 or latest revision thereof will be made available or provided. These records will be representative test results for Section 6.1 and certificate of testing for Section 6.2. An affidavit of testing for the valve assembly as outlined in Section 6.2.2 of ANSI/AWWA C-509-01, (350-ft. lb.) will also be provided. A copy of the manufacturer's Quality Assurance Program will be submitted. Blueprints and parts list for the valve must also be provided.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. (2) The full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full rated unbalanced working water pressure. In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows: 200-ft. lb. for a 3 in. and 4 in. nominal diameters, and 300-ft. lb. for a 6 in. 8 in., 10 in., and 12 in. nominal diameters. For sizes larger than a 12 in. nominal diameter, refer to the manufacturer's Specifications.

Resilient seats must be applied to the gate and must seat against a corrosion resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in compliance with ANSI/AWWA C-550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D-429 either method A or method B must prove the method used for bonding or vulcanizing. For method A, the minimum strength must not be less than 250 psi. For method B, the peel strength must be 75 lb./in.

The end flanges of flanged valves must conform to dimensions and drillings of ANSI/AWWA C-110/A21.10 or ANSI B-16.1, Class 125.

Mechanical joint bell dimensions must conform to ANSI/AWWA C-111/A21.11. Push-on joints must conform to the requirements of ANSI/AWWA C-111/A21.11.

The tapping valves must be mechanical joints with tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway.

The seat rings must be of a large diameter to the permit entry of the full diameter tapping machine cutters. The valve end which mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will be dimensioned in accordance with MSS SP-60 for valves 20-in. nominal pipe size and smaller.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve. When assembled, valves manufactured in accordance with this standard must be well fitted and operate smoothly. All like parts of valves of the same model and size produced by the same manufacturer must be interchangeable.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed.

Repaired valves must comply with the testing requirements of this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

All gate valves must be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and zero pressure applied to the other side. The test is to be made in each direction across the gate. All tests are to be performed at the manufacturer's plant.

All gate valves must be operated through a complete cycle in the position for which it was designed to ensure free and proper functioning of all parts in the intended manner. Any defects in workmanship must be corrected and the test repeated until satisfactory performance is demonstrated. All tests are to be performed at the manufacturer's plant.

A hydrostatic test pressure equal to twice the rated working pressure of the valve must be applied to all assembled valves with the gates in the open position. The test must show no leakage through the metal, pressure containing joints, or stem seals. All tests are to be performed at the manufacturer's plant.

A test must be made from each direction at rated working pressure to prove the sealing ability of each valve from both directions of flow. The test must show no leakage through the metal, pressure containing joints, or past the seat. All tests are to be performed at the manufacturer's plant.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, and the designation of working water pressure, for example "200 W."

The San Antonio Water System may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal from the approval list.

2.8.1.3. **Workmanship**. All parts of the resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C-509-01 or latest revision thereof and this Specification.

All parts of the resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The resilient seat gate valves must be well fitted. Operation of the resilient seat gate valve must be smooth. All parts must be free of structural defects. The resilient seat gate valve must be watertight.

2.8.1.4. **Painting**. All exterior and interior surfaces of the valve must be coated with epoxy, NSF 61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C-550, latest revision.

Coating must be as close to holiday free as is technologically possible.

2.8.1.5. **Testing**.

Hydrostatic Test: Hydrostatic Test must be performed on the valve in accordance with Section 6.1, "Proof of Design Testing" of ANSI/AWWA C-509-01 or latest revision thereof.

Torque Test: Torque Test for prototype valves must be performed on the valve in accordance with Section 6.1, “Proof of Design Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

Leakage Test: Leakage Test must be performed on the valve in accordance with Section 6.1, “Proof of Design Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

Pressure Test: Pressure Test must be performed on the valve in accordance with Section 6.1, “Proof of Design Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

Operation Test: Operation Test must be performed on the valve in accordance with Section 6.2, “Production Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

Shell Test: Shell Test must be performed on the valve in accordance with Section 6.2, “Production Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

Seat Test: Seat Test must be performed on the valve in accordance with Section 6.2, “Production Testing” of ANSI/AWWA C-509-01 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3, “Affidavit of Compliance” of ANSI/AWWA C-509-01.

The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve must be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and must be approved by the San Antonio Water System.

2.8.1.6. **Quality Assurance**. Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. Non-compliance to this registered commercial quality system requirement by June 2001 will result in removal of the manufacturer's product from the approved manufacturers list. If on receipt of resilient seat gate valves they are found to be non-compliant the manufacturer must replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets the San Antonio Water System's Specifications. The defective resilient seat gate valve will be returned to the manufacturer, freight collect, and the manufacturer must replace the resilient seat gate valve, freight prepaid. If San Antonio Water System audits, product inspection and performance data review in accordance with these Specifications determine excessive resilient seat gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the resilient seat gate valve becomes defective during the manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the resilient seat gate valve according to size with a resilient seat gate valve that meets the San Antonio Water System's Specifications. The defective resilient seat gate valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the resilient seat gate valve, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

2.8.1.7. **References**.

American National Standards Institute and American Water Works Association Standard C-509-01 (ANSI/AWWA C-509-01).

Manufacturers Standardization Society MSS SP-60.

2.8.2. **Reduced Wall, Resilient Seated Gate and Tapping Valves AWWA C515-01**. This product Specification covers reduced wall resilient seated gate valves, with nominal diameters of 4 in. through 48 in. Sizes refer to the nominal diameter, in in., of the waterway through the inlet and outlet connections and the closure area.

All products furnished must conform to ANSI/AWWA C515-01) or latest revision thereof and Manufacturers Standardization Society Standard Practice for Connecting Flange Joint Between Tapping Sleeves and Tapping Valves MSS SP-60 or latest revision thereof.

2.8.2.1. **Definitions**. All definitions are defined according to ANSI/AWWA C515-01.

2.8.2.1.1. **Cosmetic Defect**. A blemish, which has no effect on the ability of the component to meet the structural design and production test requirements of this standard. Should the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, and then the blemish will be considered a structural defect.

2.8.2.1.2. **Flanged Joint**. The flanged and bolted joint as described in ANSI/AWWA C110/A21.10 or ANSI B16.1, Class 125.

2.8.2.1.3. **Mechanical Joint**. The gasketed and bolted joint as described in ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, or ANSI/AWWA C153/21.53.

2.8.2.1.4. **Push-on Joint**. The single rubber gasket joint as described in ANSI/AWWA C111/A21.11.

2.8.2.1.5. **Structural Defect**. Flaws that cause the component to fail the structural design or test requirements of this standard. This includes, but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall- thickness requirement, or failure to meet production tests.

2.8.2.1.6. **Tapping Valve**. A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure.

2.8.2.2. **General Requirements**. Except as otherwise modified or supplemented herein, ANSI/AWWA C515-01 or the latest revision thereof, will govern the design, component materials, construction; manufacture and testing of all reduced wall resilient seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The San Antonio Water System reserves the right to limit the purchase of reduced wall resilient seat gate valves from manufacturers and to the models specified, as shown on the SAWS website - https://www.saws.org/business-center/construction-material-specs/, provided such reduced wall resilient seat gate valves conform to the provision contained herein.

The minimum design working water pressure for gate valves with nominal diameters of 4 in., 6 in., 8 in., 10 in., 12 in., 14 in., and 16 in. must be 200 psig unless otherwise specified.

The maximum fluid velocity for flow through the valve in full open position must be 16 ft. per sec.

Valves must be reduced wall, resilient-seated types, bronze mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open the valve must have a clear, full-port, unobstructed waterway.

Gray iron, ductile iron, steel, brass, and bronze materials must meet or exceed the material requirements of Section 4.2, “Materials” of AWWA C515-01 and Table 3 below.

Table 3
Reduced Wall, Resilient Seated Gate and Tapping Valves

Material	Standard
Gray Iron	ASTM A 126, Class B
Ductile Iron	ASTM A 536 no more than 0.08% phosphorous
Steel	SAE Grade 2, ASTM A 307, and zinc plated
Bronze	ASTM B 763 UNS C 99500
Bronze Stem Nuts Only	ASTM B 62 UNS C 836000 ASTM B 584 UNS C 84400

Gaskets, O-rings, Coatings, and elastomers must meet or exceed the material requirements of Section 4.2, “Materials” of AWWA C515-01.

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves designed for buried installation must have a stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM recognized alloy Specifications of low zinc content bronze, as shown in Section 4.2, “Materials” of ANSI/AWWA C515-01 or the latest revision thereof. Material for the stem must have minimum yield strength of 40,000 psi. A minimum elongation in 2 in. of 12% and must be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material must comply with the requirements shown above. The stem must have a visible external marking at the top to indicate low-zinc, high strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements of ASTM A307 with dimensions conforming to ANSI B18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of ductile iron: bonnet and body. Shell thickness must meet the minimum thickness requirements of Table 1 Minimum Thickness of Body and Bonnet of Section 4.4, “Detailed Design” of ANSI/AWWA C515-01. Valves larger than 16 in. must meet the performance requirements of the San Antonio Water System resilient seat reduced gate valve Specification.

If glands and bushings are used for the valves must be made of ASTM B763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B763 bronze UNS C99500. The gate may be made of bronze ASTM B763 UNS C99500. Stem seals must be “O” ring type. The seals must be designed for dynamic applications. The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the “O” ring packing plate must be in accordance with Section 4.4.6, “Stem Sealing” of ANSI/AWWA C515-01 or the latest revision thereof.

Enclosed and buried valves must be coated inside and outside with a fusion bonded epoxy with a nominal 8 mils dry film thickness, which meets or exceeds AWWA C550-01 and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service per ANSI/NSF 61.

The bidder must submit with his proposal three sets of certified drawings showing the principal dimensions, general construction and material Specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this Specification must be supplied from the San Antonio Water System approved manufacturer list on the SAWS website - https://www.saws.org/business-center/construction-material-specs/.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. In no case must the pressure be less than 500 psi without any visual deformation. (2) The full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full rated unbalanced working water pressure. In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows: 200-ft. lb. for a 4 in. nominal diameter, 300-ft. lb. for a 6 in., 8 in., 10 in., and 12 in. nominal diameters, 400-ft. lb. for a 14 in. through 20 in. nominal diameters, and 600-ft. lb. for a 24 in. nominal diameter.

Resilient seats must be applied to the gate and must seat against a corrosion resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in compliance with ANSI/AWWA C550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D429 either method A or method B must prove the method used for bonding or vulcanizing. For method A, the minimum strength must not be less than 250 psi. For method B, the peel strength must be 75 lb. per in.

The end flanges of flanged valves must conform to dimensions and drillings of ANSI/AWWA C110/A21.10 or ANSI B16.1, Class 125.

Mechanical joint bell dimensions must conform to ANSI/AWWA C111/A21.11. Push-on joints must conform to the requirements of ANSI/AWWA C111/A21.11.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, the letters "C515," and the designation of working water pressure, for example "200 W." Markings must conform to Section 6.1, "Marking" of ANSI/AWWA C515-01 or latest revision thereof.

The San Antonio Water System may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal of the manufacturer from the attached approval list.

The tapping valves must be configured with a mechanical joint on one end and a tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway. The seat rings must be of a large diameter to permit the entry of the full diameter tapping machine cutters. The valve end which mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will be dimensioned in accordance with MSS SP-60 for valves 20 in. nominal pipe size and smaller.

2.8.2.3. **Workmanship**. All parts of the reduced wall resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C515-01 or latest revision thereof and this Specification.

All parts of the reduced wall resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another reduced wall resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this Specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The reduced wall resilient seat gate valve must be well fitted. Operation of the reduced wall resilient seat gate valve must be smooth. All parts must be free of structural defects. The reduced wall resilient seat gate valve must be watertight.

2.8.2.4. **Painting**. All exterior and interior surfaces of the valve must be coated with epoxy, NSF 61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C550, latest revision.

Coating must be as close to holiday free as is technologically possible.

2.8.2.5. **Testing**.

Hydrostatic Gate Test: Hydrostatic Gate Test must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof.

Torque Test: Torque Test for prototype valves must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof. Prototype valves larger than 16 in. must meet the torque requirements of Section 2.7.2.2, “Design Criteria for Ball Type Curb Stops/Angle Valves” above.

Leakage Test: Leakage Test must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof.

Hydrostatic Shell Test: Hydrostatic Shell Test must be performed on the valve in accordance with

Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof. Valves larger than 16 in. must be shell tested at twice the rated working pressure but at least 500 psi.

Production Test: Production Test must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof. This same test must apply to valves larger than 16 in.

Operation Test: Operation Test must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof.

Seat Test. Seat Test must be performed on the valve in accordance with Section 5.1, “Testing” of ANSI/AWWA C515-01 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3, “Affidavit of Compliance” of ANSI/AWWA C515-01.

The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve must be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and must be approved by the San Antonio Water System.

2.8.2.6. **Quality Assurance**. Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system. If on receipt of reduced wall resilient seated gate valves they are found to be non-compliant the manufacturer must replace the defective reduced wall resilient seated gate valves according to reduced wall resilient seated gate valve size with a reduced wall resilient seated gate valve that meets the San Antonio Water System's Specifications. The defective reduced wall resilient seated gate valve will be returned to the

manufacturer, freight collect, and the manufacturer must replace the reduced wall resilient seated gate valve, freight prepaid. If San Antonio Water System audits, product inspection and data review in accordance with these Specifications determine excessive reduced wall resilient seated gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the reduced wall resilient seated gate valve becomes defective during the manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the reduced wall resilient seated gate valve according to size with a reduced wall resilient seated gate valve that meets the San Antonio Water System's Specifications. The defective reduced wall resilient seated gate valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the reduced wall resilient seated gate valve, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

2.8.2.7. **References**.

American National Standards Institute and American Water Works Association C509-01 (ANSI/AWWA C509-01).

Manufacturers Standardization Society MSS SP-60.

2.8.3. **Tapping Valves and Tapping Sleeves**. This Section covers tapping sleeves installed on pipe from 4 in. and larger nominal pipe diameter.

2.8.3.1. **General Requirements**. Band must conform to the minimum OD size ranges and lengths specified in Table 8. The flange must be manufactured in compliance with AWWA C-223-07, Class D ANSI B.16.1 drilling, recessed for tapping valves MSS-SP60. Mechanical Joint tapping sleeve outlet must meet or exceed all material Specifications as listed below and be suitable for use with standard mechanical joint x mechanical joint resilient wedge gate valves per ANSI/AWWA C-509-94.

2.8.3.2. **Tapping Sleeves from 4 in. Through 12 in. Nominal Pipe Diameter**. Entire fitting to be stainless steel type 304 (18-8). The body, lug, and gasket armor plate to be in compliance with ASTM A-240. The flange must be cast stainless steel in compliance with ASTM A-743. The MJ outlet must be one-piece casting made of stainless steel. The test plug must be 3/4 in. NTP in compliance with ANSI B2.1 and must be lubricated or coated to prevent galling. All metal surfaces must be passivated after fabrication in compliance with ASTM A-380.

The gasket is to provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under combinations of joint and gasket tolerances. The materials used must be vulcanized natural or synthetic rubber with antioxidants and antioziant ingredients to resist set after installation. No reclaimed rubber should be used. A heavy-gauge-type 304-stainless armor plate must be vulcanized into the gasket to span the lug area.

The lugs are to be heliarc welded (GMAW) to the shell. Lug must have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts must not be integrally welded to the sleeve. Finger Lug designs are not approved; it is the intent of these Specifications to allow tapping sleeve that has a lug design similar to the approved models.

Bolts and nuts must be type 304 (18-8) stainless steel and lubricated or Teflon coated to prevent galling or seizing. Bent or damaged unit will be rejected.

Quality control procedures must be employed to ensure that the shell, Lug, (4 in. and larger nominal pipe diameter) armor plate, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 200 psi, and a test pressure of 250 psi.

The sleeve construction must provide a positive means of preventing gasket cold flow and extrusion.

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent type, water resistant that will not smear or become illegible.

2.8.3.3. **Tapping Sleeves 16 in. and larger nominal pipe diameter**. The body must be in compliance with ASTM A285 Grade C or ASTM A36. Test plug must be 3/4 in. NPT conforming to ANSI B2.1.

The gasket is to provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gasket will be formed from vulcanized natural or synthetic rubber with antioxidants ingredients to resist set after installation. No reclaimed rubber will be used.

Bolts and nuts must be type high strength, corrosion resistant, low alloy per AWWA C-111, ANSA A21.11

Quality control procedures must be employed to ensure that the shell, gasket, and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 150 psi, and a test pressure of 200 psi.

Unless otherwise noted, unit must be protected by fusion Epoxy 8-10 mil line and coat per AWWA C-213.

Units for concrete steel cylinder pipe must be furnished with load bearing set screws on the gland flange to transfer loads on the outlet away from the steel cylinder and onto the sleeve. Epoxy-coated tapping sleeves do not require grout seal cavity. (AWWA Manual of Practice M-9)

Each sleeve must be stenciled, coded, or marked in a satisfactory manner to identify the size range. The markings must be permanent type, water resistant that will not smear or become illegible.

See Table 4 for Standard Dimension Ranges:

Table 4
Standard Ranges: (4 in.–30 in. Nominal Pipe Diameter)

Nominal Dia. (in.) x Min Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[2]
4 x 16	4	A	4.75–4.95
		B	4.90–5.10
6 x 16	4	A	6.70–7.10
		B	7.00–7.40
		C	7.35–7.75
6 x 16	6	A	6.80–7.15
		B	7.05–7.40
		C	7.40–7.75
8 x 16	4 & 6	A	9.00–9.45
		B	9.35–9.70
		C	9.70–10.10
8 x 20	8	A	9.00–9.35
		B	9.35–9.70
		C	9.70–10.00
10 x 16	4 & 6	A	11.03–11.47
10 x 20	8	B	11.60–12.00
10 x 24	10[1]		
12 x 16	4 & 6	A	13.00–13.40
12 x 20	8	B	13.40–13.80
12 x 24	10	C	14.10–14.50
12 x 32	12[1]		
16 x 12	4 & 6		17.33–17.87
16 x 16	8		18.62–19.19
16 x 20	10[1]		

Nominal Dia. (in.) x Min Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)[2]
16 x 24	12[1]		
16 x 36	16[1]		
20 x 12	4 & 6	A	21.51–22.15
20 x 16	8	B	23.46–24.16
20 x 20	10[1]		
20 x 24	12[1]		
20 x 36	16[1]		
20 x 40	20[1]		
24 x 12	4 & 6	A	25.71–26.41
24 x 16	8	B	28.14–28.84
24 x 20	10[1]		
24 x 24	12[1]		
24 x 36	16[1]		
24 x 40	20[1]		
24 x 48	24[1]		
30 x 12	4 & 6	A	29.78–30.48
30 x 16	8	B	31.52–32.22
30 x 20	10[1]		
30 x 24	12[1]		
30 x 36	16[1]		
30 x 40	20[1]		
30 x 48	24 x 30[1]		

1. Range to be specified when ordered.
2. Ranges may be broadened by not narrowed. For concrete steel cylinder pipe the OD of the pipe and cylinder must be supplied with the order.

For pipe larger than 30 in. nominal diameter, tapping sleeves must be custom fabricated to fit nonstandard ranges, in conformance with the intent of these Specifications.

The San Antonio Water System may, at no cost to the manufacturer, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

Please see SAWS website for a list of approved manufacturers. https://www.saws.org/business-center/construction-material-specs/.

2.9. **Butterfly Valves**. This Section covers class 150/250 rubber-seated butterfly valves, 4 in. through 54 in. All products furnished must be in accordance with ANSI/AWWA C504 or latest revision thereof; however, the body construction of the valve must exceed the ANSI/AWWA C504 by the values specified herein. All coatings in contact with potable water must be certified to NSF 61. A proof of design certification must be provided upon request.

2.9.1. **Definitions**. All definitions are defined according to ANSI/AWWA C-504.

Actuator: A device attached to the valve for the purpose of rotating the valve disc to an open, closed, or intermediate position; preventing disc over travel; and maintaining the disc in any position.

Butterfly Valve: A valve that uses a disc rotatable through an angle of approximately 90° as a closure member. The valve is closed when the disc is perpendicular to the flow way, open when parallel to the flow way, or used for throttling when positioned between open and closed.

Disc: The closure member that is positioned in the flow stream to permit flow or to obstruct flow (depending on closure position) and that rotates through an angle of 90° from full open to full shutoff.

Rubber Seat: A rubber ring around the inside of the valve body to affect a seal against the metal seating surface when the disc is closed or resilient seats must be located on the valve disc and must provide a 360° continuous, uninterrupted seating surface. Seats must be mechanically retained with a stainless-steel retaining ring and stainless steel Nylok cap screws, which must pass through both the resilient seat and the retaining ring.

The resilient seat's mating surface must be to a 360° continuous, uninterrupted stainless steel body seat ring. The retaining ring must be continuous or investment cast with overlapping sections serrated grooves, and shoulders.

2.9.2. **General Requirements**. Except as otherwise modified or supplemented herein, AWWA C504 or the latest revision thereof, will govern the design, component material construction, manufacture and testing of all butterfly valves.

The San Antonio Water System reserves the right to limit the purchase of butterfly valves from manufacturers and to the models specified on the SAWS website - https://www.saws.org/business-center/construction-material-specs/, provided such butterfly valves conform to the provisions contained herein.

Valves must be Class 150/250 of the short-body type with a 150/250 psig bi-directional shut-off rating, a 500 psig hydrostatic body shell test and a maximum upstream line velocity rating according to Table 5 listed below unless specified otherwise.

Table 5
Butterfly Valves Max Velocity

Diameter	Velocity
3 in. through 20 in.	16 ft./sec.
24 in. through 72 in.	8 ft./sec.

Valve must be in the same alignment as a horizontal pipe and must be for buried service, unless otherwise specified. Valve must be configured with a horizontal valve shaft and a vertical actuator shaft with standard 2 in. AWWA operating nut. The actuator must be side mounted.

Valve body must be of cast iron conforming to ASTM Specification A-26, Class B, or Ductile Iron ASTM A536, grade 65-45-12.

Valve body ends must be flat-faced flanged in accordance with ANSI B16.1, Class 150/250. All cast iron valves must exceed minimum body shell thickness AWWA C504 Class 150B/250B, Table 2 of Section 3.1, "Valve Bodies."

Laying lengths for flanged and wafer valves and minimum body shell thickness for all body types by the following: Sizes 3 in. through 10 in. - 15% or greater, Sizes 12 in. through 24 in. - 20% or greater, and Sizes 30 in. through 54 in. - 50% or greater. Ductile iron valve body thicknesses must conform to the table below. Ductile iron and cast iron laying lengths must be as specified in tables 6a and 6b below unless otherwise specified.

Table 6a
Ductile Iron Valves Laying Length

Valve Diameter (in.)	Thickness (in.)	Laying Lengths (in.)
3	0.37	5
4	0.40	5
6	0.43	5
8	0.46	6
10	0.54	8
12	0.58	8
14	0.63	8
16	0.68	8
18	0.79	8
20	0.83	8

Valve Diameter (in.)	Thickness (in.)	Laying Lengths (in.)
24	0.93	8
30	1.10	12
36	1.22	12
42	1.35	12
48	1.48	15
54	1.63	15
60	1.89	15
66	2.00	18
72	2.375	18

Table 6b
Cast Iron Valves Laying Length

Valve Diameter	Thickness	Laying Length (In.)
6	Per Specification	6
8–12	Per Specification	8
14–30	Per Specification	12
36–54	Per Specification	15

Valve must be of such design that the disc will seat at 90° with the pipe axis.

Valve must be of such design that the disc will not flutter or vibrate when operated in a throttled position.

Valves disc must be of Cast Iron A-48, Cast Iron A-126, class B or Ductile Iron ASTM A-536, grade 65-45-12 and must be of disc design to provide 360° uninterrupted seating.

The valve seat must be natural or synthetic rubber and may be applied to the disc or body. For valves 24-in. or larger, the rubber seat must be capable of mechanical adjustment in the field and must be field replaceable. Special tools required for seat adjustment must be provided with the valve. Special tools required for seat replacement must be furnished with the replacement seat. Mechanical adjustment or attachment of the seat and seat ring does not include welding. The mating seat surface must be type 304 or type 316 stainless steel, ni-chrome or monel. Sprayed or plate mating seat surfaces are not acceptable.

Valve shafts must be type 630 stainless steel conforming to ASTM A-564 condition H-1100 and must have a diameter equal to or greater than that shown for Class 150B in Table 3 of AWWA C504. Shafts must conform to the requirements of Section 3.3, “Valves Shaft” of AWWA C504 for one-piece or stub shaft types.

Connection between the shaft and disc must be dowel, taper pins, or torque plugs, which are mechanically secured.

The valve assembly must be furnished with a factory-set, non-adjustable disc shaft thrust bearing that ensures the valve disc is centered within the valve body seat at all times.

Valve shaft bearings must be permanent, self-lubricated bearings which provide continuous, low-friction maintenance-free operation. Shaft bearing must be contained in integral hubs of the valve body.

Valve shaft seal must consist of O-ring, V-type, or U-cup type packing where the shaft projects through the valve body for the actuator connection.

The valve must be provided with a fully enclosed, permanently lubricated actuator of the traveling nut or worm gear design. The actuator must be connected to the valve shaft by means of a key and keyway connection.

All actuators must have adjustable, mechanical stop limits in accordance with AWWA C504, Section 3.8.2. All 4 in.–54 in. valve actuators must be capable of withstanding 450-ft. lb. of input torque against the open or closed stops without damage.

Valves for below ground applications must be provided with an AWWA wrench nut. The wrench nut must have an arrow cast thereon, indicating the direction on of opening. The wrench nut must be suitably fastened to the actuator input shaft. If the shaft is smooth, the wrench nut must be fastened to the input shaft by means of a minimum 5/16 in. diameter steel pin passing entirely through the shaft and the wrench nut. Key with keyway will be acceptable. If the shaft is splined, the wrench nut must be formed to fit the splined shaft. The actuator must be designed to produce the specified torque with a maximum input of 150-ft. lb. applied to the wrench nut.

Valves for aboveground applications must be provided with a handwheel. The handwheel must have an arrow thereon, indicating the direction of the opening. The handwheel must be suitably fastened to the actuator input shaft. Actuators equipped with handwheels must be designed to produce the specified torque with a maximum pull of 80 lb. of the handwheel rim.

The requirement for either wrench nut or handwheel and the direction of opening will be specified on each purchase order.

The bidder must submit with his proposal three sets of certified drawings showing the principal dimensions, general construction and material Specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents.

The supplier/manufacturer must provide Affidavit of Compliance with applicable sections of AWWA C504 to include the following: Results of ASTM testing procedures and requirements for materials will be provided to the Owner upon request, Manufacturer's Quality Assurance Program, leak-tightness testing and proof of design testing of representative actuators in accordance with AWWA C504, Section 3.8.5.2 as modified herein (450-ft. lb.). Compliance assurance will be required in accordance with AWWA C504, Section 5.1.2, “Affidavits.” Results of performance tests, proof of design test, AWWA C504, Section 5.2.4, “Hydrostatic test, leakage test, and Affidavit of Compliance” must be provided with the bid or with the shipping documents and must be approved by the San Antonio Water System.

2.9.3. **Workmanship**. All parts of the butterfly valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C509 or latest revision thereof and this Specification.

All parts of the butterfly valve manufactured by a given manufacturer must be interchangeable with like parts from another butterfly valve of the same model and size and by the same manufacturer.

2.9.4. **Painting**. All interior and exterior ferrous surfaces of the valve, including the disc, must be coated with epoxy, NSF 61 certified or fusion bonded epoxy, NSF 61 certified. The epoxy (or fusion bonded epoxy) must have a nominal thickness of 8 mils, and must be in accordance with AWWA C550, latest revision.

Coating must be as close to holiday free as is technologically possible.

2.9.5. **Testing and Inspection**.

Performance Tests: Performance tests must be performed on each valve in accordance with Section 5.2.1, “Testing” of ANSI/AWWA C504 or latest revision thereof.

Leakage Tests: Leakage tests must be performed on each valve in accordance with Section 5.2.2, “Testing” of ANSI/AWWA C504 or latest revision thereof.

Hydrostatic Tests: Hydrostatic tests must be performed on each valve in accordance with Section 5.2.3, “Testing” of ANSI/AWWA C504 or latest revision thereof.

Proof-of-Design Tests: Proof-of-Design tests must be performed on each valve in accordance with Section 5.2.4, “Testing” of ANSI/AWWA C504 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided.

The Affidavit of Compliance and the records of all tests performed on the valves must be kept and provided in a single hard cover bound notebook.

2.9.6. **Quality Assurance**. Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system. If on receipt of butterfly valves they are found to be non-compliant the manufacturer must replace the defective butterfly valves according to butterfly valve size with a butterfly valve that meets the San Antonio Water System's Specifications. The defective butterfly valves will be returned to the manufacturer, freight collect, and the manufacturer must replace the butterfly valve, freight prepaid.

If San Antonio Water System audits, product inspection and performance data review in accordance with these Specifications determine excessive butterfly valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the butterfly valve becomes defective during the Manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the butterfly valve according to size with a butterfly valve that meets the San Antonio Water System's Specifications. The defective butterfly valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the butterfly valve, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

2.9.7. **References**.

American National Standards Institute and American Water Works Association C504 (ANSI/AWWA C504).

2.10. **Valve Boxes**. This Section covers cast-iron valve box assemblies.

2.10.1. **General Requirements**. Each valve box assembly must be of cast-iron and must consist of a base, top section, and lid as shown on the plans.

Valve boxes must be of a single size with a nominal diameter of 6 in.

The valve box lid must be labeled "water" and must be so designed so that it will remain firmly seated in place when subjected to vehicular traffic.

The valve box assembly must have enough toughness and strength to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly must be coated with a standard bituminous coating of either coal tar or asphalt basic applied to all inside and outside surfaces.

2.11. **Meter Boxes**. This Section covers meter boxes for 5/8 in., 3/4 in., 1 in., 1-1/2 in., and 2 in. meters.

2.11.1. **General Requirements**. For non-traffic bearing locations, the meter box assembly for 5/8 in. through 1 in. meters must be made from 100% high-quality recycling plastic. The meter box and lid must be black and constructed out of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection. The black material must be uniform throughout the meter box and lid for maximum longevity and not have a foaming agent that creates air pockets within the plastic wall. The body and lid must withstand 20,500 lb. loading in a non-deliberate and traffic.

For traffic bearing locations, the meter box assembly for 5/8 in. through 2 in. meters must consist of a cast-iron rectangular box and a steel checkered plate rectangular cover with raised lug pattern as shown on the plans.

2.11.2. **Specific Requirements**.

2.11.2.1. **Plastic Lid**. Must have the following:

"Water Meter" and "SAWS" molded into the lid.

Seat securely and evenly inside the meter box and must not overlap the top edge of the meter box "Overlap" and securely and evenly on the existing SAWS cast iron meter box with like dimensions.

A diamond pattern for skid resistance and an AMR Slide Mount molded into the lid on the underneath side and off center for placement for an AMR transponder to help in the protection of the radio antenna.

A brass worn gear lock that will secure the existing SAWS cast iron meter box of like dimensions and secure the plastic meter box. See detail on plans.

A molded receptacle for placement of SAWS key.

One (1) piece of 1/2 in. rebar secured in lid. See detail.

2.11.2.2. **Plastic body**. Must have the following:

A crush resistant ribbing along the outside of box.

A flange around the top opening to help prevent setting and aide in adjustment to grade. Designed to accommodate all plastic lids.

2.11.2.3. **Cast Iron Rectangular box for Traffic Bearing Locations**. Must have the following: Ultimate tensile strength of 25,000 psi and must not be brittle.

"As cast" clean smooth surface and be free from internal porosity, castings that are made smooth by grinding will not be considered.

Be dipped in a coal tar at a temperature of 350°F and the metal must be at a temperature of 300°F before dipping. The casting should be dipped and cured independently and the coating must have ceased to be "tacky" within 72 hr. after dipping.

The steel checkered plate rectangular cover is to be hot dip galvanized after fabrication.

2.11.3. **Quality Assurance**. If on receipt of meter boxes or lids they are found to be non-compliant, the manufacturer must replace the defective boxes or lids with a replacement that meets the San Antonio Water System's Specifications, at no charge to San Antonio Water System. Any visible defect or failure to meet the quality standards herein will be ground for rejecting the entire order.

Product that is non-compliant will be returned to the manufacturer, freight collect and the manufacturer will replace the defective product, freight prepaid within thirty (30) days from receipt of the defective product.

2.12. **Fire Hydrants**. This Section covers post-type, dry-barrel fire hydrants with compression shut off (opening against pressure) or gate shutoff for use in water supply service in all climates, including those where freezing occurs. All products furnished must conform ANSI/AWWA C502-05 or latest revision thereof and must be UL approved.

2.12.1. **Definitions**. All definitions are defined according to ANSI/AWWA C502-05.

2.12.1.1. **Cosmetic Defect**. A blemish that has no effect on the ability of a component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding,

grinding, or repairing such blemishes cause the component to fail these requirements, and then the blemish must be considered a structural defect.

2.12.1.2. **Structural Defect**. A flaw that causes a component to fail the structural design or test requirements of this standard. This includes but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet minimum wall thickness requirements, or failure to meet production tests.

2.12.1.3. **Bury**. The length of bury is the distance measured to the nearest 1/2 ft. from the bottom of the connecting pipe to the ground line of the hydrant.

2.12.2. **General Requirements**. The San Antonio Water System reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified, as shown on the SAWS website - https://www.saws.org/business-center/construction-material-specs/ provided such fire hydrants conform to the provision contained herein.

Each hydrant must be designed for a minimum working pressure of 200 psig.

All parts of the hydrant must be designed to withstand, without being functionally impaired or structurally damaged, a hydrostatic test of not less than 400 psig or twice the rated working pressure, whichever is greater, with the hydrant completely assembled and pressurized as follows:

With the nozzle caps in place, the main valve open, the hydrant inlet capped, and the test pressure applied to the interior of the hydrant.

With the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet. The design safety factor of the operating mechanism must not be less than 5 and must be based on the ft. lb. of torque required for the closing and opening of the hydrant at a working pressure of 200-psig. Hydrants must be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200-lbf. ft. at the operating nut in the opening direction with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5 ft. bury or less.

The length of bury must be as specified but not less than 4 ft. The fire hydrant must have two hose nozzles and one pumper nozzle. The nominal inside diameter of the hose nozzle must be 2.5 in. The nominal inside diameter for the pumper nozzle must be 4 in. The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections. The nominal diameter of the main valve opening must be 5.25 in. The hydrant shoe must be provided with a 6 in. mechanical joint connection to fit the connecting pipe. The fire hydrant must open right (clockwise). The color of the finish paint above the ground line must be aluminum; however, fire hydrants for private use must be painted red. The fire hydrant must have a non-rising stem. No more than one 6 in. stem extension must be provided if required to make the base of the fire hydrant grade level.

The bonnet section must be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir must be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir will be sealed. The reservoir will be adequately sealed with “O” rings or other suitable sealing system approved by the San Antonio Water System.

The fire hydrant must have a safety flange or breakaway flange at the ground line as stipulated in Section 3.1, “General Design” of ANSI/AWWA C-502-05 or latest revision thereof.

Fire hydrant nozzle cap chains will be required and must be attached permanently to the fire hydrant as stipulated in Section 3.2, “Detailed Design” of ANSI/AWWA C-502-05 or latest revision thereof.

Parts that require lubrication and come into contact with water must be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

2.12.3. **Workmanship**. All foundry and machine work must be performed in accordance with good standard practice for the class of work involved and in conformance with accepted drawings, if required. When assembled, hydrants manufactured in accordance with this Specification must be well fitted and must operate smoothly. The body and shaft must be watertight.

All parts must conform to the required dimensions and must be free from defects that could prevent proper functioning of the hydrant.

All castings must be clean and sound without defects that will weaken their structure or impair their service.

2.12.4. **Paint**. The exterior surface of the hydrant must be coated with a coating that must meet or exceed the requirements of Federal Specification TT-C-494b. A second coat of water based or oil-based enamel paint aluminum in color will then be applied from the top of the hydrant to a point 18 in. to 20 in. below the centerline of the pumper nozzle or down to the traffic safety flange connection at the ground line.

All interior surfaces, machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, must be coated with a coating that must meet or exceed Federal Specification TT-C-494b. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

The interior and exterior of the hydrant shoe must be coated with a fusion-bonded epoxy with a nominal dry film thickness of 8-mils, conforming to ANSI/AWWA C-550-05, and certified to NSF 61.

Coating must be as close to holiday free as is technologically possible.

2.12.5. **Testing and Inspection**. Each assembled hydrant must be subjected to two shop tests under a hydrostatic pressure of 400 psig or twice the rated working pressure, whichever is greater. One test must be made with the entire interior of the hydrant under pressure and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there should be no leakage through the main valve or seals or through the castings or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valves must not exceed 5 fl. oz./min. Other leakage or other imperfections found in either test must be corrected or the hydrant retested. The tests must be conducted for enough time to allow a check of all points of possible leakage and for a minimum of 30 sec. after all air has been exhausted.

Each assembled hydrant must be operated through a full open-close cycle when not under pressure. The torque required for performing this operation must not exceed 20-lb. ft.

All fire hydrant tests and inspections must conform to ANSI/AWWA C-502 Section 5.1, “Production Testing,” ANSI/AWWA C-502 Section 5.2, “Prototype Testing,” and ANSI/AWWA C-502-05 Section 5.3, “Inspection and Rejection.”

The manufacturer must provide an Affidavit of Compliance conforming to Section 1.7, “Affidavit of Compliance” of ANSI/AWWA C-502-05 or latest revision thereof.

2.12.6. **Quality Assurance**. Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. Noncompliance to this registered commercial quality system requirement by June 2001 will result in removal of the manufacturer's product from the approved manufacturers list. If on receipt of fire hydrants they are found to be noncompliant the manufacturer must replace the defective fire hydrants according to fire hydrant size with a fire hydrant that meets the San Antonio Water System's Specifications. The defective fire hydrants will be returned to the manufacturer, freight collect, and the manufacturer must replace the fire hydrant, freight prepaid. If San Antonio Water System audits, product inspection and performance data review in accordance with these Specifications determine excessive fire hydrant non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the fire hydrant becomes defective during the manufacturer's

specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the fire hydrant according to size with a fire hydrant that meets the San Antonio Water System's Specifications. The defective fire hydrant removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the fire hydrant, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

2.12.7. **Maintenance Kits**. The San Antonio Water System will attempt to use fire hydrant maintenance kits in the repair of the approved hydrants. Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.12.8. **References**.

American National Standards Institute and American Water Works Association C-502-05 (ANSI/AWWA C-502-05).

American National Standards Institute and American Water Works Association C-550-05 (ANSI/AWWA C-550-05).

2.13. **Polyethylene Wrapping Material**. This Section covers polyethylene-wrapping material for use in encapsulating ductile and cast iron pipe.

2.13.1. **General Requirements**. Polyethylene wrapping for ductile and cast iron water mains is to consist of an 8 mil tubular section of linear low-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast-iron and ductile-iron pipe from the electrolytic action encountered in highly active soils. Polyethylene wrapping is to consist of opaque linear low- density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 7 below for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain a minimum of 4 ft. over the actual pipe length to allow for overlap.

The polyvinyl sheet of film for the tubular wrapping is to be of virgin resins meeting raw and physical properties of ASTM D-1248 and AWWA C-105, latest edition. The material is to be8 mil linear low-density polyethylene of uniform film thickness and be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product will have a nominal thickness of 8 mils, with tolerances of minus 10%.

The polyethylene wrapping material is to have no volatile constituents, the loss of which may affect ductility. The material is also to have the following properties:

- Mechanical: The polyethylene film is to have a tensile strength per latest ASTM D-882 test, of 3600 psi min. The film is to have an elongation of not less than 700% of the test strip per latest ASTM D-882 test. The film is to have an impact resistance 600 gram min per (ASTM D-1709 Method B). The film is to have a propagation tear resistance of 2550 gf minimum in machine and transverse direction (ASTM D1922).
- Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per latest ASTM D-149.
- Inspection and Certification by Manufacturer:
  - *Quality control and inspection*. The manufacturer must establish the necessary quality control and inspection practice to ensure compliance with this standard.
  - *Manufacturer's statement*. The manufacturer must, provide a sworn statement on each lot purchased that the inspection and all applicable material requirements of Section 2.13, "Polyethylene Wrapping Material" below have been met and that all results comply with the requirements of this standard.

- *Freedom from defects*. All polyethylene film must be clean, sound, and without defects that could impair service.

2.13.2. **Marking Requirements**. The polyethylene film supplied must be clearly marked, at a minimum of every 2 ft. along its length, containing the following information:

- Manufacturer's name or trademark
- Year of manufacture
- ANSI/AWWA C-105/A21.5
- Minimum film thickness and material type.
- Applicable range of nominal pipe diameter sizes.
- Warning-Corrosion Protection-Repair any Damage.

The San Antonio Water System may at no cost to the Contractor, subject random testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

Table 7
8 Mil Polyethylene Wrapping Materials
Size & Length (All sizes lay flat size)

Pipe Size (in.)	Product Size Width (in.) x Length
4, 6 & 8	20 x 200/500
8, 10 &12	27 x 200/500
16 & 18	37 x 200/500
20	41 x 200/500
24	54 x 200/500
30	67 x 140/500
36	81 x 120/500
48	95 x 100/500
54	108 x 100/500

2.14. **Standard/Wide Range Ductile Iron Couplings**. This Section covers ductile iron couplings for use in connection of smooth end joints of cast iron, ductile iron, asbestos cement, steel, PVC, or other types of pipe. The couplings must be capable of fitting this variety of pipes with one set of follower flanges or end rings.

2.14.1. **General Requirements**. Sleeve or center ring must be nominal O.D. size range and length specified. Sleeve must be of Ductile Iron ASTM A536. Ends must have a smooth inside taper to provide uniform gasket seal. Sleeve must be given a shop coat of oil–modified urethanes, corrosion-resistant paint, or epoxy coating.

Follower flanges or end rings must be of the thickness determined by the coupling size, and must be ductile iron, ASTM-536. Flanges must be identified by a color-coded shop coat finish as described in Section 2.13.2, "Marking Requirements."

Gaskets must be compression – type, formed with Virgin Styrene Butadiene Rubber (SBR,) ASTM D2000 3 BA715, and compounded with ingredients to produce permanence and resistance to set after installation. O.D. range must be imprinted/molded on the gasket in permanent ink (Minimum).

Bolts and Nuts must be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values must be in accordance with AWWA/ANSI C111/A21.11.

Where Specification states a cast transition or reducing coupling in place of a straight coupling, the sleeve and follower flange must be of the same manufacturer and compatible for the specific use intended.

Quality control procedures must be employed to ensure that the sleeve, follower flanges and gaskets are properly fabricated and free of any visible defects. Each coupling must have a working-pressure rating not less than the following, as shown in Table 8:

Table 8
Ductile Iron Couplings

Pipe Size (in.)	Minimum Working Pressure Rating (psi)
16 and smaller	175
20	150
24	150

2.14.2. **Straight Coupling Ranges**. Refer to Table 9 for Ductile Iron Straight Coupling Ranges and Table 10 for Ductile Iron Wide Range Coupling.

Table 9
Ductile Iron Straight Coupling Ranges

Nominal Diameter (in.) x Minimum Length (in.)	O.D. Range[1](in.)
4 x 6	4.80–5.10
6 x 6	6.90–7.22
8 x 6	9.05–9.45
10 x 6	11.10–11.60
12 x 6	13.20–13.50 13.78–14.38
16 x 6	17.40–17.80 18.46–19.00
20 x 7	21.35–21.75 21.75–22.25
24 x 10	25.00–25.80 26.10–26.32

1. Ranges may be broadened, but not narrowed.

Table 10
Ductile Iron Wide Range Coupling

Coupling Size (in.)	O.D. Range1(in.)
3	3.40–4.20
4	4.20–5.33
6	6.25–7.45
8	8.40–9.79
10	10.70–12.12
12	12.75–14.38

1. Ranges may be broadened, but not narrowed

The San Antonio Water System may, at no cost to the manufacturer, subject random couplings to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.14.3. **Approved Manufacturers**. Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.15. **Air Release, Vacuum, and Combination Air Valves**. This Specification covers automatic valves installed on water mains to vent accumulated air under system pressure, and to provide air exhaust during initial fill or to prevent a vacuum during draining or water column separation of the system.

2.15.1. **General Requirements**. Valves furnished under this Specification must conform to ANSI/NSF 60 for direct additives and ANSI/NSF 61 for indirect additives. Cast Iron Valve Body and cover must be in accordance with ASTM A48-35 or ASTM A126 class B. Non-Metallic Valve Body must be fabricated from fiberglass reinforced nylon. Inlet sizes through 2 in. must be screwed (NPT). Pipe sizes 3 in. and above must have flanged inlets (125# ASNSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Metallic Internal seat trim float arm and pivot pin must be stainless steel type 303, 304 or 316. Metallic Floats must be stainless steel ASTM A 240. Other stainless steel metal internal parts must be stainless steel ASTM A240 or ASTM A276.

Non-metallic floats must be foamed polyethylene with stainless steel type 316 fasteners.

Valves requiring Internal seats or orifice buttons must be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket must be composition type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. If an O-Ring is used to seal the cover, it must be on NSF 61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2 in. and below.

Valve body must have a test pressure rating of 300 psi and working pressure rating of 150 psi.

All components in contact with potable water must be “lead free” and marked by stamping, etching, or casting “NL” in the main body.

2.15.2. **General Operation Requirements**. The air release valve must be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be simple-lever, compound-lever, ball and orifice or rolling seal depending upon volume requirements and the design of the valve.

The air and vacuum valve must be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable or automatically allowing large quantities of air to be exhausted during the filling cycle an also capable of automatically allowing air to re-enter the system to prevent a negative pressure at water column separation or during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves must provide for both automatic air release under system pressure and to allow air movement during filling or draining operations or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sized (4 in. and larger) may be furnished in a dual housing. When dual casings are used a bronze manual isolation valve must be installed if indicated by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

2.15.3. **Tests**. The San Antonio Water System may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standards herein will be grounds for rejecting the entire order.

2.15.4. **Quality Assurance**. The manufacturers must provide certification that products furnished under this Specification are manufactured in an ISO 9001 certified facility or documentation from an accredited facility that ISO 9001 certification is in process.

Please see SAWS website for a list of approved manufacturers - https://www.saws.org/business-center/construction-material-specs/.

2.16. **Reinforced Concrete Vaults**.

2.16.1. **General Requirements**. Concrete used should be transit mix and must have a 28-day compressive strength of 5,000psi with a maximum slump of 6 in. and a minimum slump of 3 in. Cement must conform to the requirements of the latest provision of ASTM C-150 and C-156, or most applicable approved equal provision.

2.17. **Blow-off Assemblies**. The materials required for both permanent and temporary 2 in. and 4 in. blow-off assemblies must conform to the Specifications contained herein and as shown on the plans.

2.18. **Backfill**.

2.18.1. **Bedding/Initial Backfilling**. The bedding and initial backfill materials for concrete steel cylinder pipe (CSC), ductile iron pipe (DI), HDPE Pipe, Wrapped Steel Pipe, and Polyvinyl Chloride Pipe (PVC) in all nominal diameters must be composed or well graded crushed stone or gravel conforming to the following Table 11 requirements unless modified by the Engineer.

Table 11
Modified Grade 5 Gravel

Gradation Sieve Size	% Retained
1/2" sieve	0%
3/8" sieve	0–5%
No. 4 sieve	20–80%
No. 10 sieve	75–100%
No. 20 sieve	98–100%

The quantity and thickness of lifts and compaction of initial backfill materials is to be in accordance with Section 3.3, "Backfill" of this Specification.

Where copper, HDPE or PEXa services (3/4 in. – 2 in.) are installed, initial backfill must be sand conforming to the following requirements: Natural sand or sand produced from crushed gravel or crushed rock maximum 1/4 in.; 95% must pass No. 4 sieve, free from clay and organic material, with a maximum 8% passing the No. 200 sieve. Larger services using ductile iron pipe or PVC C-900 pipe must be backfilled the same as mains.

2.18.2. **Secondary Backfill for Water Mains**. Secondary backfill is defined as backfill from 1 ft. above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed in accordance with details shown in the construction documents.

Secondary backfill must generally consist of materials removed from the trench and should be free of brush, debris, and trash. Rock or stones with a dimension larger than 6 in. at the largest dimension must be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material should be primarily composed of compactible soil materials. The secondary backfill material must be placed in maximum 12 in. loose lifts or as directed.

2.19. **Pavement**. All pavement should adhere to TxDOT specifications and as shown on plans.

2.20. **Concrete**. All concrete used as the trench cap and in sidewalks and blocking mains is to conform to Item 421, "Hydraulic Cement Concrete." Class "A" concrete is to be used in sidewalks and for blocking concrete steel cylinder mains; Class "C" concrete is to be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

2.21. **Reinforcing Steel**. All bar reinforcement is to be Grade 60, conforming to the requirements of Item 440, "Reinforcement for Concrete."

2.22. **Affidavit of Compliance**. Unless otherwise directed, the Contractor is to furnish a manufacturer's affidavit of compliance for each of the materials used in this project. The affidavit is to certify that factory inspection and all specified tests have been made and that the material furnished complies with the requirements outlined herein.

2.23. **Recycled Water System**. All material used in the improvement, adjustment, removal, or construction of the recycled water system must meet these standards (i.e., uses of CSC pipe, trenching and excavation, etc.), except as otherwise noted, and must be wrapped or painted with pantone 512 color.

2.24. **Grouting of Water Mains**. This Section will govern the grouting of existing water mains with diameter of larger than 4 in. for the purposes of abandonment underneath roadways, paved areas, and at other designated locations. The location of this Work is as shown on the Contract Document plans or as encountered in the field during construction. The Contractor must, unless otherwise specified, furnish all labor, materials, equipment, tools and all other appurtenances necessary to abandon water lines segments in place by filling them with flowable cementitious low strength grout including plugs, bulkheads, excavation and

backfill at locations as required to completely fill the line to be abandoned in place to protect against future collapse of the line.

Submittals for Grouting Water Mains:

- Proposed Mix Design Report for grout
- Submit manufacturers data for proposed plugs and detail of bulkhead
- Technical information for equipment and operations procedures including projected injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design and number of stages of grout application.
- Submit project specific plan for abandonment at least 15 days before commencing grouting activities, describe proposed sequence, access points and other appropriate information for completion of Work.

Materials for Grouting Water Mains:

- Cement-based grout/flowable fill with self-leveling and non-shrink characteristics.
- Unconfined compressive strength: Minimum 100 psi at 56 days as determined based on average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

2.25. **Remove Existing Water Lines**. All materials designated to be removed must become the Contractor's property and must be disposed of in an approved and permitted disposal site, The Contractor must obtain approval before disposing of any material.

3. CONSTRUCTION

3.1. **Excavation**. Excavation (trenching) as required to complete the water main installation is to be performed in accordance with Item 400, "Excavation and Backfill for Structures," as outlined herein, as shown on the plans and as directed.

3.1.1. **Trenches**. Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1 ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints should be dug after the trench bottom has been graded and bedding installed. The pipe should rest upon the new bedding material for its full length.

Where over-excavation occurs, the under-cut trench must be restored to grade at no cost to the Department by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.1.2. **Width of Trench**.

3.1.2.1. **Minimum Width of Trench**. The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and not greater than the width at the top of the trench.

3.1.2.2. **Maximum Width of Trench**. The maximum allowable width of trench for pipelines measured at the top of the pipe must be the outside diameter of the pipe (exclusive of bells or collars) plus 24 in. A trench wider than the

outside diameter plus 24 in. may be used without special bedding if the Contractor, at his sole expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the Specifications, or by the written approval of the Engineer, the Contractor, at his sole expense, must encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Over excavated trenches should be backfilled, compacted and re-excavated (NSPI). Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's sole expense.

3.1.3. **Classification of Excavated Materials**. No classification of excavated materials will be made. Excavation and trench work is to include the removal and subsequent handling of all materials excavated in accordance with Item 400, "Excavation and Backfill for Structures."

3.1.4. **Grade of Trench Bottom**. The trench is to be over-excavated to a depth of 6 in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.

3.1.5. **Excavation Below Grade**. Any part of the bottom of the trench excavated below the limits specified in Section 3.1.4., "Grade of Trench Bottom," is to be corrected with approved material and compacted by mechanical tamping or other means which must provide a stable foundation for the pipe. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.1.6, "Unstable Conditions at Grade," at no cost to SAWS.

3.1.6. **Unstable Conditions at Grade**. Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to a depth at least 12 in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3 in. before mechanical compaction to provide stable foundation. The layers are to be slightly moistened and thoroughly compacted so as to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints. The payment for this will be subsidiary to the related main installation.

3.1.7. **Trench Excavation Protection**. All trench excavation required on this project is to be accomplished as required by the provisions of Item 402, "Trench Excavation Protection."

3.1.8. **Caution in Excavation**. The Contractor is to proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12 in. on either side of other existing underground utilities. The Contractor is to be responsible for the repair of such structures and utilities when broken or damaged. He is also to be responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the water main construction.

Whenever it is necessary to explore and excavate to determine the location of existing underground structures and utilities within the proposed main alignment, the Contractor is to make explorations and excavations for such purposes at his expense.

3.1.9. **Protection and Restoration of Underground Structures and Facilities**. The Contractor is to furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work. All underground structures and utilities which are disturbed are to be restored by the Contractor at his expense. Materials and methods used for restoration are to be in accordance with current building codes with local amendments, the Department's Utility Accommodation Policy (UAP) (Title 43, T.A.C., Sections 21.31—21.55), and the requirements of the utility agency involved.

If a sanitary sewer is broken by the Contractor's operations the release of sewage into the trench is to be immediately intercepted by the insertion of a section of sheet metal tubing known as a "tin-horn" between the broken ends of the sewer. All leakage at the ends of the "tin-horn" is to be effectively stopped. The "tin-horn" is to remain in place until permanent repairs can be made. It is to be the responsibility of the Contractor to determine in advance of his trenching operations the size of all sanitary sewer lines and services which will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, are to have proper support consisting of sound timber supports with a minimum 2 in. nominal thickness and a minimum 6 in. nominal width placed with the width horizontal and extending a minimum of 12 in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material is to be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to a distance of 6 in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged are to be properly marked, and care is to be taken to avoid damage to the pipe by a hydra tamping machine or other mechanical equipment. The Contractor is to be liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. **Backfill Material Derived from Excavation**. Any excess excavated material, not used after all fill requirements have been met, must become the responsibility of the Contractor. The Contractor must transport and dispose of it outside the limits of the rights-of-way or easements of this project and of public thoroughfares and water courses, to a permitted fill site in conformity with all applicable City, County, State and Federal codes and ordinances and without liability to SAWS or any individual.

3.1.11. **Trench Restoration**. The surface of the backfilled trench must be restored to match the previous existing conditions. This will include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained grass), or other unprepared and prepared surfaces.

Trenches in paved streets must be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface must be a minimum of 4 in. compacted and rolled asphaltic black base, either hot-mix or cold-mix applied. It is the Contractor's responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed before final asphalting.

All street work must be done in accordance with the latest Department construction specifications. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for temporary surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

3.1.12. **Pavement**. The Contractor is to remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration is to be as specified on plans. The Contractor is to saw-cut the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond what is required for the work and the limits specified in plans, such pavement and surfaces are to be restored at the expense of the Contractor.

Where water line construction necessitates cutting through existing streets outside the limits of new street construction, said streets are to be replaced per existing conditions.

Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor is to install temporary metal bridges as necessary to facilitate the movement of traffic. Steel plates should adhere to ASTM A283.

The street surface adjacent to the trench is to be kept free of surplus spoil. Construction materials are to be placed at locations that will minimize interference with the traveling public.

3.1.13. **Restore Concrete Sidewalks, Driveways, Curbs, etc**. All concrete sidewalks, driveways, curbs, etc., refer to TxDOT specs for removal and replacement requirements.

Payment for removal and installation of concrete sidewalks, driveways, curbs, etc. being replaced as part of the TxDOT project scope, will be paid by TxDOT according to the related pay items.

3.1.14. **Dewatering**. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

Contractor should notify SAWS inspector whenever ground water is encountered.

The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Engineer must order immediate shutdown, and remedial measures will be responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Owner.

The Contractor must maintain ground water table at least 12 in. below the finished excavation subgrade.

Performances of the dewatering system for lowering ground water must be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the Owner.

No direct payment will be made for costs associated with dewatering. All costs in connection therewith will be included in the applicable contract price for the item to which the work pertains.

3.2. **Pipe Laying**.

3.2.1. **General Requirements**. The Contractor is to start his work at a tie in point, unless otherwise indicated on the plans. Pipe is to be laid with bell ends facing the direction of lying, unless otherwise authorized or directed by the Owner. Under no circumstances is pipe to be laid in water and no pipe is to be laid under unsuitable weather or trench conditions. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe is to be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots are to be centered in bells or collars, all valves and hydrant stems are to be set plumb, and fire hydrant nozzles are to face as shown on the plans or as directed by the Owner. No valve or other control on the existing system is to be operated for any purpose by the Contractor unless a representative of SAWS is present.

The Contractor is to maintain a neat and orderly work area. Complete cleanup is to be maintained at all times as closely behind the pipe laying operations as possible, but in no case is such cleanup be permitted to lag more than 1,000 ft. behind the pipe laying, unless otherwise directed.

The Contractor is to maintain service to water connections, whether connected to the existing or proposed water lines, at all times for the duration of the construction, unless directed otherwise by the Engineer.

3.2.2. **HDPE Pipe**. Pipe and fittings must be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures. The butt-fused joint will be true alignment and will have uniform roll back beads resulting from the use of proper temperature and pressure. The joint surfaces will be smooth. The fused joint will be watertight and will have tensile strength equal to that of the pipe. All joints will be subject to acceptance by the Engineers or his representative before insertion. All defective joints will be cut out and replaced. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10% of the wall thickness, will not be used and must be removed from the site. In addition, if in the opinion of the Engineers or his representative any section of pipe has other defects, including those hereinafter listed, that may indicate damaged, improperly manufactured, faulty, or substandard pipe, said pipe will be discarded and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling.

The manufacturer must provide fusion training. The contractor (actual installers) and the onsite joint inspector must be trained by the manufacturer or manufacturer's authorized representative.

It will not be permitted to join unlike DRs to one another. Transition from unlike SDRs must be accomplished by mechanical couplings capable of identical pressure ratings or machined polyethylene nipples where a thicker wall polyethylene has been matched to the companion pipe wall.

Mechanical joining systems: Polyethylene pipe and fittings must be connected by means of a polyethylene flange adapter and backup ring. The polyethylene flange adapter will be of the same specifications as the Light View except will be made from black plate stock. This method is also approved to join to another piping system or valves. Mechanical compression couplings or full circle encasement clamps may be used depending on the test specification.

Mechanical couplings must be installed in accordance with the mechanical coupling manufacturer's recommended procedures.

The fusion equipment and operator must be required to demonstrate successful field experience. Regarding fusion over 36 in. capability, the fusion unit must be field tested for a period of five years and the fusion operator must have pipe size experience of the same pipe on the project for five years or longer.

It will not be permitted to join unlike DRs to one another. Transition from unlike SDR's must be accomplished by mechanical couplings capable of identical pressure ratings or machined polyethylene nipples where a thicker wall polyethylene has been matched to the companion pipe wall.

Mechanical joining systems: Polyethylene pipe and fittings must be connected by means of a polyethylene flange adapter and backup ring. The polyethylene flange adapter will be of the same specifications as the Light View except will be made from black plate stock. This method is also approved to join to another piping system or valves. Mechanical compression couplings or full circle encasement clamps may be used depending on the test specification.

Mechanical couplings must be installed in accordance with the mechanical coupling manufacturer's recommended procedures.

The fusion equipment and operator must be required to demonstrate successful field experience. Regarding fusion over 36 in. capability, the fusion unit must be field tested for a period of five years and the fusion operator must have pipe size experience of the same pipe on the project for five years or longer.

Installation should be in accordance with ASTM D2774, AWWA M55, and as specified in this Specification. No pipe should be installed where the interior or exterior surfaces show damage that may jeopardize the integrity of the pipe as determined by the SAWS' Inspector. Such damaged pipe should be replaced with a new undamaged pipe. All pipe damaged prior to end of construction should be replaced at contractor's expense.

Transportation, Unloading, and Storage: Contractor's activities will comply with the requirements of this section. Transport, handle, and store pipe and fittings as recommended by manufacturer. Contractor to notify SAWS' Inspector a minimum of 4 hours prior to the delivery and unloading of pipe. SAWS' Inspector may choose to be present at time of delivery. Contractor is not to unload pipe until SAWS' Inspector is present or has informed Contractor to proceed with unloading. During loading, transportation, and unloading, every precaution should be taken to prevent damage to the pipe. If new pipe and fittings become damaged before or during installation, it should be repaired as recommended by the Manufacturer or replaced as required by the SAWS' Inspector at the Contractor's expense, before proceeding further. All pipe and accessories should be loaded and unloaded by lifting with hoists or by skidding in order to avoid shock or damage. Proper facilities should be provided for lowering sections of pipe into trenches. Under no circumstances should pipe, fittings, or any other material be dropped or dumped into trenches. Protect the pipe from sharp edges when overhanging the bed of a truck or trailer by placing a smooth, rounded protecting strip on the edge of the bed. The load should be anchored securely to prevent slippage. Lengths of small-diameter, lightweight pipe can be unloaded manually. Dragging the pipe into place is not permitted. Pipe handled on skidways should not be rolled or skidded against pipe on the ground. Slings, hooks, or pipe tongs should be padded and used in such a manner as to prevent damage to the exterior surface or interior of the pipe. The joints should be handled near the middle with wide web slings and bars. The use of chains, end hooks or cable slings that may scar the pipe are not permitted. Slings for handling the pipe should not be located at butt-fused joints. All pipe and fittings should be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor. Materials, if stored, should be kept safe from damage. The Contractor should be responsible for all security, damage, and loss of pipe. The interior of the pipe as well as all sealing surfaces of mating components (i.e., flange faces) should be kept free from dirt or foreign matter at all times. The open ends of all sections of joined and installed pipe (not in service) should be plugged to prevent animals or foreign material from entering the pipeline or pipe section. The practice of stuffing cloth or paper in the open ends of the pipe will not be permitted. Where possible, the pipe should be raised and supported at a suitable distance from the open end such that the open end will be below the level of the pipe at the point of support. Where necessary due to ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports. Pipe should be stored in such a way as to prevent sagging or bending and protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. The expansion and contraction caused by uneven heating by the sunlight should be prevented by restraining the racks.

Cleaning: Before placement of pipe in the trench, all pipe and fitting should be thoroughly cleaned of any foreign substance that may have collected thereon and should be kept clean at all times thereafter. Openings of all pipes and fittings in the trench should be closed during any interruption to the Work.

Placement: HDPE mains should be laid to the depth shown in the contract documents. Pipe should be laid directly on the imported bedding material. No blocking should be permitted, and the bedding should be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations should be made as needed to facilitate removal of handling devices after the pipe is laid. Initial backfill should be consolidated to a point 12 inches above installed pipeline. In addition, the compaction and other requirements should be as specified in this specification. All pipes in place must be approved by the Inspector before backfilling. Pipe should be protected from lateral displacement by pipe embedment material installed as specified in this Specification. Pipe should not be laid in water or under unsuitable weather or trench conditions, and should

be protected against entry of foreign matter Lay the pipe so that no high or low points other than those on the plans are introduced. To prevent high points or low points along the pipeline, the general slope of the pipeline should not be changed between vertical angle points. When pipe is to be connected to existing pipe, the terminus of the existing pipe should be field located prior to fabricating new pipe. The Contractor should submit any required alignment adjustments to the Engineer for acceptance. The Contractor should make any required field alignment adjustments to allow proper fit-up of pipe in conformance with tolerances specified. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and the grades. Whenever pipe laying is stopped, the open end of the line should be closed with an inflatable pipe plug end board or other water tight seal to keep water and debris from entering the interior of the pipe. Any standing water should be removed from the trench before the inflatable pipe plug or end board is removed.

Laying Lengths: Maximum pipe laying lengths should be limited to the requirements of the City of San Antonio Street Cut permit. Contractor should comply with City of San Antonio Street Cut permit All trenches must be closed at end of day with an all-weather surface or steel plate. Open trenches during non-working hours are not permitted.

When the HDPE pipe has been placed in the trench and backfilled, the Contractor should leave the end sections exposed to allow for expansion and contraction of the pipe. After 24 hours or once the pipe has reached ambient temperatures of the existing ground (trench), the end section(s) can be connected to the fitting or existing pipe.

Cutting Pipe: Cutting should be in accordance with the pipe Manufacturer's recommendations. Cuts should be smooth, straight, and at right angle to the pipe axis. After cutting, the end of the pipe should be dressed to remove all roughness and sharp corners.

Jointing: All HDPE pipe should be joined to itself by the heat fusion process per ASTM F2620 and ASTM F1290 which produces homogeneous, leak tight joints or by mechanical coupling. Sections of HDPE pipe should be joined above ground into continuous lengths by the thermal butt fusion method. Socket fusion, extrusion welding, and hot gas welding will not be acceptable. Contractor should minimize use of mechanical couplings to join the plain ends of HDPE pipe and should plan work stoppage to coincide with locations of mechanical fittings indicated in the plans where possible. Use of other than butt fusion or electrofusion should be in accordance with the Contractor’s approved fusion plan or as approved by the Engineer. If in ditch butt fusion or electrofusion cannot be utilized, mechanical couplings should be from SAWS’ APL and approved for use with HDPE by manufacturer but must be approved by SAWS prior to installation. Jointing of pipe and mechanical fittings should be performed in accordance with the instructions and recommendations of the pipe and fitting Manufacturer. Mechanical and flanged fittings should be installed in accordance with the fitting manufacturer’s recommended procedures. Stainless steel stiffener inserts should be utilized at all fittings.

Butt Fusion: The pipe should be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints should be made in compliance with the pipe or fitting Manufacturer’s recommendations. Fusion joints should be made by qualified fusion technicians per ASTM F3190.A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F3190.Considerations should be given to and provisions made for adverse weather conditions, such as cold air temperatures, precipitation, or wind, which is accepted by the Engineer. For 6” and larger pipe sizes, the pipe butt fusion machine should be a self-contained hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord (25' minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be by McElroy, or Engineer approved equivalent. The butt-fused joint will be true alignment and will have uniform roll back beads resulting from the use of proper temperature and pressure. The joint surfaces will be smooth. The fused joint will be watertight and will have tensile strength equal to that of the pipe. All joints will be subject to acceptance by the Inspector prior to installation. All defective joints will be cut out and replaced at no cost to SAWS. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in

depth than 10% of the wall thickness, will not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. Pipe having defects that in the opinion of the Inspector indicate the pipe may be damaged, faulty, substandard, improperly manufactured, or have other defects as listed herein, will be discarded and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling. All fusions should be made with fusion equipment equipped with a Data Logger. Contractor should submit Data Logger reports to SAWS' Inspector for each previous day's pipe fusion.

Fusion Data Recording: The device should be capable of meeting the requirements of ASTM F 3124, "Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings". The device, or combination of devices, should record the following variables of each fused joint:

Heater surface temperature immediately before inserting the heater plate. Alternatively, the heater plate may be measured with a pyrometer and entered into the weld record.

Gauge pressure during the initial heat cycle.

Gauge pressure and elapsed time during the heat-soak cycle.

Heater removal (dwell) time.

Gauge pressure and elapsed time during the fusing/cool cycle.

Drag pressure.

Pipe diameter and wall thickness.

Type of HDPE material (Specification and Classification) and Manufacturer.

Fusion Machine Identification.

The device should record the operator, a unique operator ID number, the date and time of each weld. Records showing the device is up to date on all required calibration should be available for presentation when requested. All fusion welds should be traceable to the report (via operator and weld ID) with permanent paint marker/pen only, next to fusion weld. When requested prior to commencement of work, a weld location map may be requested by the SAWS' Inspector or SAWS' representative. All joining procedures should be acceptable to SAWS' Engineer. Threaded or solvent cement joints and connections are not permitted. All equipment and procedures will be used in strict compliance with the manufacturer's recommendations. Fusing will be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and fusing equipment.

Electrofusion: Electrofusion joining should be done in accordance with the manufacturers recommended procedure, ASTM F 1290, PPI TN 34, PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE), and PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 14 Inch to 30 Inch Polyethylene (PE) Pipe (MAB-02).The process of electrofusion requires an electric source, commonly called an electrofusion processor that has wire leads and a method to read electronically (by laser) or otherwise input the barcode of the fitting. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician should be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project and successful demonstration of jointing procedures through a destructive test as indicated in this specification Contractor

should perform electrofusion in strict conformance with MAB procedures. Contractor should prepare ditch as required to allow adequate space for preparatory work and cleaning. Inspector may reject any electrofusion coupling installation which lacks witness marks for stab depth or lacks evidence of proper cleaning and scraping prior to fusing.

Fusion Operators: The Contractor of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The Contractor is responsible for documenting all qualification and training records of that individual. All HDPE fusion equipment operators should be qualified to the procedure used to perform pipe joining. Fusion equipment operators should have current, formal training on all fusion equipment employed on the project. When the fusion machine operator is employed by the HDPE pipe and fusion machine supplier, the supplier should maintain an ISO 9001 Certified Quality Management System.

Flange Installation: Flange connections should be installed in accordance with the Manufacturer's recommended procedure. Flanges should be centered and aligned to the mating component before assembling and tightening bolts. In no case should flange bolts be used to draw the connection into alignment. Bolt threads should be lubricated, and flat washers should be used under the nuts. Bolts should be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least 1 hour after initial assembly, flange connections should be retightened following the tightening pattern and torque step recommendations of the Manufacturer. Connections should be retightened a second time after at least 4 hours in accordance with Manufacturer's recommendations. The final tightening torque should be as recommended by the gasket Manufacturer.

Connections with Existing Piping: Connections between new work and existing piping should be made using connections as shown on Drawing Series DD-812. To minimize effects from temperature shrinkage, connections to existing piping should only be made after pipeline is backfilled and pipeline has reached ambient temperature of the existing ground (trench). Connection to existing piping should only be made after concrete anchor reaction blocks have been in place at least seven (7) days. Contractors should coordinate connection so that SAWS Inspector is in attendance during connection installation and testing. Each connection with an existing pipe should be made at a time and under conditions that will least interfere with service to customers, and as authorized by SAWS. Facilities should be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property. Special care should be taken to prevent contamination of potable water lines when dewatering, cutting into, and making connections with existing pipe. Trench water, mud, and other contaminating substances should be kept out of the lines. The interior of all pipe, fittings, and valves installed in connections to existing piping should be thoroughly cleaned and then swabbed in accordance with the requirements of AWWA C651.Connections to existing piping should be fully restrained in accordance with Manufacturer's recommendations.

Direct Burial: Buried HDPE pipe and fittings should be installed in accordance with ASTM D 2321 or ASTM D 2774 for pressure systems and AWWA Manual of Practice M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) should be considered acceptable design and installation conditions. Pipe embedment and bedding – Embedment/bedding material should be as specified in this Specification. Initial backfill should be mechanically consolidated as specified in this Specification, “Excavation, Trenching and Backfill.” Secondary backfill should be as specified in this Specification.

Valves: Valves should be handled in a manner to prevent any injury or damage to any part of the valve. Joints should be thoroughly cleaned and prepared prior to installation. The Contractor should adjust stem packing and operate each valve prior to installation to insure proper operation. Valves (body and seat) should not be subjected to test pressures greater than valve Manufacturer's recommendation. Valves should be installed so that the valve stems are plumb and in the location show on Drawings. Verify clearance of valve disc rotation with inside of flange adapter on HDPE pipe. Provide factory beveled flange adapter as needed to provide free clearance of the valve disc.

Pipe Deflection: The minimum allowable bending radius should be not less than the radius shown in the Drawings.

Concrete Encasement: Concrete encasement should be installed as indicated on the drawings. Concrete and reinforcing steel should be as specified in the Contract Documents. All pipes to be encased should be suitably supported and blocked in proper position and should be anchored against flotation.

Reaction Anchorage and Blocking: All fittings on HDPE pipe should be mechanically restrained. Fittings should meet requirements of Specification Section 2.1 "Ductile-Iron Pipe and Fittings" as modified in this section. Concrete anchor blocking should be keyed into undisturbed earth on each side of the pipe as shown in the Contract Drawings and Drawing Series DD-839 and should be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking should be as indicated on the drawings or as directed by the Engineer.

Cold Weather Protection: No pipe should be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation.

No pipe should be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

Sunlight Protection: Pipe should be protected from extended exposure to sunlight, should be kept as cool as possible during installation. Pipe should be covered with backfill immediately after installation. Allow pipe to cool prior to making any connections flanges, existing pipeline systems, or structures.

HDPE Service Installation: HDPE water service installation should be in accordance with the requirements of this Specification. Service supply line connections to mains should be angled at 10 to 20 degrees or as recommended by HDPE tubing manufacturer to reduce stress at the connection to the corporation stop. Service lines should be continuous from corporation stop to the meter set. HDPE service line should be snaked loosely through the trench. Use stainless steel inserts at connection to fittings. Install tracer wire along HDPE service similar to tracer wire for HDPE main. Terminate wire neatly in 12" long (minimum) coil in meter behedge tubing. HDPE tubing approved manufacturers are listed in SAWS' APL.

3.2.3. **Crossing other Underground Lines**. New water mains crossing other utilities are to have a minimum of 30 in. of cover over the top of the pipe, unless otherwise waived or modified by the Engineer. Excavation around other utilities is to be done by hand for at least 12 in. all around. Any damage to the protective wrap on gas lines or electrodes is to be reported immediately to CPS Energy, phone (210) 353-4357. Any damage to other utilities must be reported to their proper governing entity. In any case of utility damage, Contractor must also promptly notify the Inspector.

3.2.4. **Pipe Separation – Parallel Lines**. Where a new potable waterline parallels an existing, non-pressure or pressure-rated wastewater main or lateral and the licensed Professional Engineer licensed in the State of Texas is able to determine that the existing wastewater main or lateral is not leaking, the new potable waterline must be located at least 2 ft. above the existing wastewater main or lateral, measured vertically, and at least 4 ft. away, measured horizontally, from the existing wastewater main or lateral. Every effort must be exerted not to disturb the bedding and backfill of the existing wastewater main or lateral.

Where a new potable waterline parallels an existing pressure-rated wastewater main or lateral and it cannot be determined by the licensed Professional Engineer if the existing line is leaking, the existing wastewater main or lateral must be replaced with at least 150 psi pressure-rated pipe. The new potable waterline must be located at least 2 ft. above the new wastewater line, measured vertically, and at least 4 ft. away, measured horizontally, from the replaced wastewater main or lateral.

Where a new potable waterline parallels a new wastewater main, the wastewater main or lateral must be constructed of at least 150 psi pressure-rated pipe. The new potable waterline must be located at least 2 ft. above the wastewater main or lateral, measured vertically, and at least 4 ft. away, measured horizontally, from the wastewater main or lateral.

3.2.5. **Pipe Separation – Crossing Lines**. Where a new potable waterline crosses an existing, non-pressure rated wastewater main or lateral, one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 2 ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral is disturbed or shows signs of leaking, it must be replaced for at least 9 ft. in both directions (18 ft. total) with at least 150 psi pressure-rated pipe.

Where a new potable waterline crosses an existing, pressure-rated wastewater main or lateral, one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 6 in. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral shows signs of leaking, it must be replaced for at least 9 ft. in both directions (18 ft. total) with at least 150 psi pressure-rated pipe.

Where a new potable waterline crosses a new, non-pressure-rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18 ft., one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9 ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 2 ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. The wastewater pipe must have a minimum pipe stiffness of 115 psi at 5.0% deflection. The wastewater main or lateral must be embedded in cement stabilized sand for the total length of one pipe segment plus 12 in. beyond the joint on each end.

Where a new potable waterline crosses a new, non-pressure-rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18 ft. in length, the potable water pipe segment must be centered over the wastewater line. The materials and method of installation must conform with one of the following options:

- Within 9 ft. horizontally of either side of the waterline, the wastewater pipe and joints must be constructed with pipe material with a minimum pressure-rating of at least 150 psi. An absolute minimum vertical separation distance of 2 ft. must be provided. The wastewater main or lateral must be located below the waterline.
- All sections of wastewater main or lateral within 9 ft. horizontally of the waterline must be encased in an 18 ft. (or longer) section of pipe. Flexible encasing pipe must have a minimum pipe stiffness of 115 psi at 5.0% deflection. The encasing pipe must be centered on the waterline and must be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe must be supported at 5 ft. (or less) intervals with spacers or be filled to the springline with washed sand. Each end of the casing must be sealed with watertight non-shrink cement grout or a manufactured watertight seal. An absolute minimum separation distance of 6 in. between the encasement pipe and the waterline must be provided. The wastewater line must be located below the waterline.

3.2.6. **Pipe Grade**. Water mains 16 in. or smaller must have a minimum of 60 in. of cover from the proposed final finish ground/street elevation and 60 in. of cover when the main is installed in a parkway or under the pavement where there are no existing/proposed curb or existing drainage facilities. Water mains 20 in. and above must have a minimum of 60 in. of cover over the top of the pipe from the proposed final finish ground/street elevation unless otherwise waived or modified by the Engineer.

Contractor is responsible for maintaining line grade with an electronic grade maintaining laser device. Pipe grades are to be as required on the plans, or as directed in writing. Grades are to be met as specified by Sub Article 3.1, “Excavation.” If Contractor fails to maintain grade all cost to reestablish grade must be borne by the Contractor. Care is to be taken to ensure that the pipe barrel has uniform contact with the bedding material for its full length except at couplings. The coupling is not to be in contact with the original trench

bottom before backfill. Bedding material is to be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade is to be made only at joints.

3.2.7. **Bedding and Bedding Materials**. Before placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Section 3.1, "Excavation." Approved imported materials or Engineer-approved materials selected from suitable fines derived from the excavation must be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.2.8. **Structures to Support Pipe**. When either the Inspector or Engineer note that the material at the bottom of a trench at subgrade consists of material that is notably unstable and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade must be over excavated, filled with approved material and properly compacted in place to provide a suitable base to support the pipe. If it is determined by the Engineer that this method cannot be used to stabilize the trench subgrade the Contractor must then construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. Coordinate with Engineer for approval of extra compensation before beginning work.

3.2.9. **Lowering Materials into Trench**. Proper implements, tools, and facilities satisfactory to the Engineer are to be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants are to be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and lining. Under no circumstances are water main materials to be dropped or dumped into the trench. Take care to avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.10. **Installing Pipe**. Take precautions to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. Leave the cap/plug in place until a connection is made to the adjacent pipe. Inspect the interior of each pipe for defects and reject if defects are found.

After placing a length of pipe in the trench, the jointed end is to be centered on the pipe already in place, forced into place, brought to correct line and grade, completed in accordance with the requirements specified herein. Pipe must be installed in a continuous bedding envelope which should extend the full trench width to a depth of at least 6 in. below the pipe and to a depth at least 12 in. above water pipe. The pipe is to be secured in place with approved bedding placed in lifts not exceeding 8 in. loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe. Pipe and fittings which do not allow an enough and uniform space for joints will be rejected and are to be replaced with pipe and fittings of proper dimensions. Precautions are to be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress close the open end of pipe in the trench by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor must provide plug and caps of the various sizes required.

3.2.10.1. **Steel Pipe**. The Contractor must furnish all steel piping including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories which are shown on the plans and as required for proper connection to existing piping. The Contractor must pay close attention to the fact that the exact location and elevation of existing piping must be determined in the field before fabrication of connecting piping.

All steel pipe and specials may be either mill pipe or fabricated pipe and, in either case, must be fabricated to the sizes, dimensions and shapes as indicated on the plans and as shown on the plans. Unless otherwise

indicated on the plans, all steel pipe, bends, or specials must have an outside diameter minimum wall thickness and unit weights as shown on plans.

Any pipe section, fitting, or special which shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at his own expense, replace or recondition each rejected section. All reconditioning procedures must first be presented to the Engineer for review and approval.

3.2.10.1.1. **Ends of Sections**. Ends of pipe sections, bends, and specials must be beveled for field welding, unless shown otherwise on the plans.

3.2.10.1.2. **Seams**. All piping must be made from steel plate rolled into cylinders or sections thereof, with not more than two longitudinal butt welds, or must be spirally formed and butt welded. Girth seams must be butt welded and not be closer than 6 ft. apart except in specials and bends.

3.2.10.1.3. **Length tolerance**. Standard and special section must be within 1/16 in. (±) of the specified or theoretical lengths.

3.2.10.1.4. **Welded Joints**. Except where ends are shown on the plans to be joined by mechanical couplings, all joints for steel pipe installed on a bridge structure and in open trench must be welded.

Welders appointed to do welding on steel pipe must be certified with 4F and 5G certification. All welds must be sound, free from embedded scale and slag, must have a tensile strength across the weld not less than that of the thinner of the connective sections, and be water tight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. All welds must be subject to pre-manufacturing inspection and available to the Inspector and Engineer upon request.

Welding for field joints must conform to the applicable requirements of the AWWA “Standard Specification for Field Welding of Steel Water Pipe Joints, C 206.” Parties involved in the construction of mains must pay special attention to the AWWA “Standard Specification for Field Welding of Steel Water Pipe Joints, C-206, Control of Temperature Stresses.” After welding, the joints must be prepared, primed, and painted, or wrapped in accordance with this specification.

Repair leaks in welds by grinding out defective material and re-welding. Hammering is not permitted.

3.2.10.1.5. **Split Steel Casing Pipe**. Ensure the completed and shaped trench allows for enough space to receive the casing and is wide enough to provide free working space for installing the spacers and casing and backfilling under and around the installed casing.

Hold the split casing in place for welding by using hinges, coupling bands, or any other acceptable method. Use tables, “V” notches or straps equally spaced to sustain split casing shape.

Perform welds conforming to the requirements of AWWA Standard C206. Provide welds capable of developing the full strength of the pipe throughout the joint and casing split. Ensure welds run along the horizontal plane of the split casing.

Welders appointed to do welding on steel pipe must be certified with 4F and 5G certification. All welds must be sound, free from embedded scale and slag, must have a tensile strength across the weld not less than that of the thinner of the connective sections, and must be water tight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. All welds must be subject to pre-manufacturing inspection and available to the Inspector and Engineer upon request.

Seal the ends of the encasement pipe with approved end seals.

After installation of the split steel casing, clean, prime or paint all ends of pipe adjacent to the welded field joints, including the weld proper.

3.2.10.2. **PVC (C-900)**. Lay PVC mains to the depths and grades shown on plans. Lay pipe by inserting spigot end into bell flush with insertion line or as recommended by manufacturer. At no time is bell end allowed to go past "insertion line." A gap between end of spigot and adjoining pipe is necessary to allow for expansion and contraction.

3.2.11. **Defective or Damaged Material**. Pipe and accessories are to be inspected for defects before being lowered into the trench. Any pipe section, fitting, or special which shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at his expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material is to be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor is to furnish, at his expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its condition just before the failure of the pipe. Should the Contractor damage the pipe after installation, the Engineer may permit the damaged section to be cut from the length unless it is the opinion of the Engineer that the entire length was damaged. The cost and replacement of broken pipe is to be at the expense of the Contractor.

3.2.12. **Holes at Bells and Collars**. Bell holes of enough size are to be provided at each joint to permit the joints to be made properly. For mechanical type joints the minimum clearance between the bell and natural ground is to be 6 in. in all directions. Bell holes for concrete steel cylinder pipe are to be of enough size to properly joint the pipe and place the required grout. Subject to the above provisions the length of excavation for bell holes below grade of the trench bottom is to be kept to a minimum.

3.2.13. **Deviations in Line or Grade**. Wherever obstructions, not shown on the plans, are encountered during the progress of the work and such obstructions interfere to such an extent that an alteration on the plan is required, the Engineer is to have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstruction. Any deviation from the line is to be accomplished by the use of appropriate bends unless such requirements are specifically waived by the Engineer. These deviations must clearly and accurately be reflected in the Contractor's submittal of their redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line the deflection is to be as directed. In no case are the amounts shown in Table 12, "Maximum Deflections of Ductile-Iron Pipe" and Table 13, "Maximum Defections of Concrete-Steel Cylinder Pipe," to be exceeded.

Table 12
Max Deflections of Ductile-Iron Pipe

Nominal Pipe Diameter	Max Joint Open	Max Deflection Angle	Max Deflection in In. with Pipe Length of:		Approximate Radius of Curve in Ft. Produced by Succession of Joints with Pipe Length of:	
(In.)	(In.)	°/min.	18 ft.	20 ft.	18 ft.	20 ft.
6	0.58	4/25	16.7	18.5	234	260
8	0.65	3/51	14.6	16.2	268	297
10	0.75	3/42	14.0	15.5	279	310
12	0.75	3/08	11.9	13.2	327	363
16	0.75	2/21	8.8	9.7	440	488
20	0.75	1/55	7.2	8.0	540	600
24	0.75	1/35	6.0	6.7	648	720

Table 13
Max Deflections of Concrete-Steel Cylinder Pipe

Nominal Pipe Diameter	Max Deflection Angle	Max Deflection in In. with Pipe Length of:		Approximate Radius of Curve in Ft. Produced by Succession of Joints with Pipe Length of:	
(in.)	°/min	16 ft.	20 ft.	16 ft.	20 ft.
16	2/20	-	9.8	-	500
20	1/52	-	7.8	-	600
24	1/34	-	6.6	-	750
30	1/16	-	5.3	-	900
36	1/02	-	4.3	-	1,100
42	0/54	-	3.8	-	1,300
48	0/47	2.6	-	1,170	-
54	0/44	2.5	-	1,237	-
60	0/54	3.0	-	1,024	-

3.2.14. **Cutting Pipe**. The cutting of pipe for inserting valves, fittings or closure pieces is to be accomplished so as to produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances is a workman not equipped with proper safety goggles and helmet and other required safety attire permitted to engage in this work.

3.2.14.1. **Asbestos-Cement (AC)**. No field cutting will be allowed on asbestos-cement pipe. Repairs to AC pipe must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings. Information about handling AC pipe can found in Section 3.2.20, “Tie-in to Existing Mains” and Section 3.2.21, “Asbestos Cement (AC) Pipe Removal” of this Special Specification.

All cuts made on ductile-iron pipe are to be done with a torch or power saw. The cuts are to be made at right angles to the pipe axis and are to be smooth. The edges of the cut are to be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of about 30°.

Field Cut PVC (C-900 and C-905 and C-909) using a power saw with a steel blade or abrasive disc depending on the size of pipe. If a bevel is needed after field cutting, it should be in accordance with the latest Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings is allowed.

3.2.15. **Coating and Wrapping Underground Pipe**.

3.2.15.1. **Steel Pipe**. Steel pipe, bends and special are to be prepared, primed, painted or wrapped in the field as follows.

Exterior Surface Above Ground: Exterior surfaces of new pipe and appurtenances installed are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat of industrial grade rust inhibitive primer and two finish coats of aluminum paint.

Exterior Surfaces Underground: Exterior surface of steel pipe, bends and specials installed in open trench are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat rust inhibitive primer and wrapped with polyvinyl tape in accordance with AWWA C-203-91 “Protective Coatings for Steel Water Pipelines,” (Appendix C), or most applicable approved equal provision.

The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe is to be as specified.

Field Welded Joints: After installation of pipe, bends, and specials, all ends of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted or wrapped as specified for the pipe adjacent to the weld.

Interior Surfaces: The interior surfaces of all steel pipe, fittings and specials must be cleaned by sandblasting and then primed and coated with a cement mortar lining. Cement mortar-lined and coated steel pipe must be used for transmission mains 4 in. and larger.

All cement-lined steel pipes must be prepared with the following processes:

Steel pipe must not be tested until the factory-applied mortar lining and coatings on all piping and specials have been in place for a minimum of 14 days. Steel piping with cement mortar field applied to the interior of the pipe must not be filled with water until a minimum of 8 hr. has elapsed after the final placement of cement mortar, unless otherwise approved by the Engineer.

- Contractor to submit details of all specials, and of the lining and coating.
- Use lining conforming to the latest provision of AWWA C205 or most applicable approved equal provision, except as is noted otherwise in the contract documents.
- Cement used in mortar lining must be Portland Cement, per the latest provision of ASTM C150 or most applicable approved equal provision, Type II or V for lining.
- Pipe must be cement mortar lined in the shop by the centrifugal process, in accordance with the latest provision of AWWA C205 or most applicable approved equal provision.

Cement mortar-lined pipe must be braced as required to maintain roundness during the shipping and handling activities and must have ends capped before shipment. For pipes with 14 in. nominal diameter and larger, the finished ID after lining must be the nominal size. For pipes with 12 in. nominal diameter and smaller, standard OD pipe sizes must be furnished.

3.2.15.2. **Ductile-Iron Pipe**.

3.2.15.2.1. **Open Trench**. Ductile-iron pipe to be installed in a trench is to be protected in the following manner. Each pipe joint is to be covered with an 8mil thick polyethylene sleeve that is 2 ft. longer than the pipe joint. The sleeve is to cover the full length of the pipe joint, lap over 1 ft. on each end of the adjoining pipe joints and be secured with a minimum of two circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of pieces of pressure sensitive tape at approximately 5 ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe is to be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint is to be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile-iron fittings are to be completely wrapped in 8 mil thick polyethylene films with a minimum of 1 ft. overlap on each end and appropriately taped. Laps are to cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve is to be wrapped as specified herein.

Any damaged areas in the polyethylene film are to be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 ft. minimum in any direction and appropriately taped. Take care at service to locations to ensure that tape extends beyond corporation and onto service line pipe 1 ft.

Before placing pipe in the trench, a cushion of approved materials is to be placed in the trench as required by Section 3.3. “Backfill” material is to be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor must use care to protect and preserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the

polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3 ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

3.2.15.2.2. **In Casing**. Where ductile-iron pipe is installed in a bore, the pipe is to be to thoroughly clean down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used is to then be applied to the pipe. Following application of prime coat, wrap pipe with Scotchrap, Trantex V-10 polyvinyl tape, or approved equal. Tape must not be applied until prime coat is completely dry.

The tape must be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap must be made to the bell on the bell end and to a point 6 in. from the spigot end. The joint must be protected with tape 6 in. in width on pipe 12 in. or less in size and with tape 8 in. in width on pipe greater than 12 in. in size.

3.2.16. **Protective Coating and Wrapping on Joints**. All bolts and nuts installed for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances are to be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint including glands, flanges, bolt heads, and nuts are to be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote are not allowed. Coating and wrapping of joints will not be paid for directly.

Steel Pipe Field Welded Joints: After installation of pipe, bends and specials, all end of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted or wrapped as specified for the pipe adjacent to the weld.

3.2.17. **Joint Assembly**.

3.2.17.1. **Rubber Ring Joints**. The installation of pipe and the assembly of rubber ring joints for ductile-iron pipe, concrete-steel cylinder pipe and asbestos cement pipe, is to conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as “stabbing” is not permitted with pipe larger than 6 in.in size. Spigot ends of pipe larger than 6 in. in size must be properly inserted in the joint by means of suitable pushing or pulling devices, or an approved manufacturer’s method.

3.2.17.2. **Mechanical Couplings**. The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Before the installation of the mechanical coupling, the pipe ends are to be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe is to be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts are to be drawn up finger tight. Uniform pressure on the gaskets is to be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning is to be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling is to then be left undisturbed for 24 hr. to allow the gaskets to “pack in.” Final torque check is to then be made before coating and wrapping the joint. Table 14, Torque for Mechanical Couplings, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

3.2.17.3. **Restrained Joints**. Install restraint joints as shown on plans or as directed by Engineer. Install in accordance with manufacturer’s recommendations.

Table 14
Torque for Mechanical Couplings

Coupling Size	Bolt Diameter	Torque
2” to 24”	5/8”	75-ft. lb.
2” to 24”	3/4”	90-ft. lb.
30” and 36” (1/4” x 7” Middle Rings)	5/8”	65-ft. lb.

Coupling Size	Bolt Diameter	Torque
30" thru 36" (3/8" & heavier Middle Rings)	5/8"	70-ft. lb.
30" to 48"	3/4"	80-ft. lb.
48" to 72"	3/4"	70-ft. lb..

3.2.18. **Gray Iron and Ductile Iron Fittings**. Fittings 6 in. through 12 in. in size are to be either mechanical joint, push-on joint short body, or push-on joint compact body unless otherwise stated on the plans. Fittings must be installed with the thrust blocking or joint restraint shown on the plans. Fittings 16 in. through 24 in. in size are to be mechanical joint type unless otherwise specified on the plans. Adaptors are to be used where necessary to provide a transition between asbestos-cement pipe and the fittings. Restraint or thrust blocking is to be provided as specified on the plans or as directed. All installed cast-iron fittings must include anti-corrosion embedment and it will not be paid for separately.

3.2.18.1. **Cleaning Ductile Iron**. All lumps, blisters, and excess coal-tar coating is to be removed from the ends of ductile-iron pipe fittings. The outside of the spigot and the inside of the bell is to be wire-brushed and wiped clean, dry, and free from oil and grease before the pipe is laid. The interior of the pipe is to be blown clean with compressed air or swabbed out clean and dry as directed. Immediately before placing any pipe in the trench the interior is to be cleaned by an approved brush or swab or with compressed air to remove all dirt and foreign materials. All pipe and fittings are to be inspected by the Contractor for defects while suspended above ground.

3.2.19. **Corrosion Protection for Ferrous Pipe, Fittings, and Valves**. Except as otherwise shown on plans or as direct, anticorrosion embedment is to be provided for all ductile-iron pipe, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material is to be Modified Grade 5 gravel washed sand which conforms to the requirements set forth in Section 2.18, "Backfill."

Prepare the trench in accordance with applicable provisions of Section 3.1, "Excavation." After subgrade has been prepared, lay pipe to grade in accordance with plans and specification. Pipe, fitting or valve are to be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket is to be 6 in. in every direction.

3.2.20. **Tie-in to Existing Mains**. The Contractor must make tie-ins from new water mains to existing water mains as shown in the contract documents or as directed. The Contractor must be responsible for all shutdowns and isolation of the existing mains; cutting pipe for the connection; dewatering the excavation; customer notification of the shutdown; and all other requirements as directed by the Inspector to provide completion of this effort in a safe and secure manner. The opening and closing of SAWS valves should be performed by the contractor in the presence of the SAWS inspector. Contractor should assist in the operation of SAWS valves. All valve operations must be in the presence of the SAWS inspector. Therefore ample coordination beforehand (2 work days) must be provided by the Contractor for this interaction to occur. All tie ins must be done after normal work hours, (8 A.M.—5 P.M.). During construction, the planned shutdown and tie in work must be coordinated through and approved by the Inspector with a minimum of twenty-five calendar days prior notice of such activity and accomplished at a time which will be at the least inconvenience to the customers. No additional compensation will be provided for tie ins accomplished after normal working hours.

Tying in to existing mains of asbestos cement (AC) pipe, the Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. At each location shown on the plans or identified by the Contractor to involve AC pipe, the Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie ins, etc.). The third party contractor will remove whole sections of AC pipe so that the Contractor can make the tie in at the nearest joint.

3.2.21. **Asbestos Cement (AC) Pipe Removal**. AC pipe removal quantities shown within plans are estimated and are to be field verified. Estimated quantities for removal are based on removal required to perform tie ins to existing AC mains (as described in Section 3.2.20, "Tie-in to Existing Mains") and locations where existing AC pipe is in conflict with proposed Department's storm drains, culverts, streets, grading, retaining walls, and traffic signal foundations. The Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie ins, etc.). The third party contractor will remove whole sections of AC pipe. Excavation required for the Removal of AC water line not related to or in direct conflict any other work will be paid by TxDOT per "Structural Excavation" item.

3.2.22. **Abandonment of Old Mains and Valves**. Regarding planned main abandonment, the Contractor must accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open ends of abandoned mains and all other openings or holes in such mains occasioned by cutting or removal of outlets must be blocked off by manually forcing cement grout or concrete into and around the openings in enough quantity to provide a permanent substantially watertight seal. Abandonment of old, existing water mains which are not grout filled will be included in the work required, and no direct payment will be made.

When specified or shown otherwise in the contract documents, Contractor must remove the main and all related appurtenances that are to replaced, or will no longer be in service, and all effort to accomplish this requirement will be included in the work required, and no direct payment will be made.

Abandoned Valves: Valves abandoned in the execution of the work must have the valve box and extension packed with sand to within 8 in. of the street surface. The remaining 8 in. must be filled with 2,500 psi concrete or an equivalent sand-cement mix and finished flush with the adjacent pavement or ground surface. The valve covers must be salvaged and returned to the Owner.

New/Existing Valves: At no time during the project work must any valves be covered or rendered inaccessible for operation due to any activities by the Contractor. Any work during construction activities will be suspended until this requirement is met. No claims for cost or schedule delays will be accepted.

3.2.23. **Jacking, Boring, or Tunneling Pipe**.

3.2.23.1. **Jacking**. Suitable pits or trenches must be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways, or other facilities and must not weaken or damage such facilities. Barricades and lights must be furnished as directed to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least ⅓ of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of not more than 2 in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe will depend on the character of the material, but it should not exceed 2 ft. in any case.

The pipe should be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans or as determined by the Engineer.

Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

3.2.23.2. **Excavation**. Excavation for "Boring" pits and installation of shoring will be as outlined under "Jacking." Boring operations may include a pilot hole which should be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade must apply as specified under "Jacking."

3.2.23.3. **Tunneling**. Tunneling may be used when the size of the proposed pipe would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring must be as specified under "Jacking." The lining of the tunnel must be of the material shown on the plans.

Access holes for grouting annular space should be spaced a maximum of 10 ft.

3.2.23.4. **Joints**. Joints for pipe for "Jacking," "Boring," or "Tunneling," must be as specified in these specifications, or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3.2.23.5. **Grouting of Bores or Tunnels**. Annular Space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise specified on the plans.

3.2.24. **Cutting in Valves**. The work involved in cutting a valve into an existing main is to consist of excavation and backfilling with approved selected material; hauling and disposition of surplus excavation and other materials; installation of the valve, valve box assembly, all pipe cut used to complete cut in; reaction blocking; polyethylene wrapping where required.

3.2.25. **Tapping Sleeves and Valves**. Size on size taps are not permitted.

The work involved in the installation of a tapping sleeve and valve is to consist of excavation, backfilling the excavation with approved selected material, installing the tapping sleeve, reaction blocking, tapping valve, valve box assembly, concrete collar (where subjected to street traffic), and a cast iron lid. New taps will not be permitted closer than 2 ft. of a joint or existing tap. The use of a shell type cutter will be required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach before start of work. The cutting edge is to be sharp and round. Inspector will reject defective cutters.

Air test tapping sleeves to 50 psi before tapping main line.

The valve box must be placed in such a manner to prevent shock or stress from being transmitted to the valve. Valve boxes must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed by the Inspector. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown in the accompanying standard drawings. When mixing concrete on site, contractor must ensure a quality product is used and should follow manufacturer mixing requirements. Any concrete deemed substandard by inspector will be replaced at no additional cost to owner. Collars around such valve boxes must be formed and finished off neatly and in a sound workmanlike manner.

3.2.26. **Cutting in Tees**. The work involved in cutting in a tee is to consist of excavation, shut-down and isolation of existing main to which the new main is to be connected, cutting pipe for connection, dewatering the excavation, customer notification of service interruption where required, installation of all pipe used to complete the connection, all necessary tie ins (connection to existing or new main), fittings, approved reaction blocking required and backfilling the excavation with approved selected materials or flowable backfill if required. Where the installation of a valve is required, payment will be for valve accordance with this specification.

The processes associated with disturbing and restoring pavements (any type), curbs, sidewalks, backfilling to final grade, flowable backfill (if required) and sodding for the installation of a cut in tee will be included in the work and must comply with the applicable Department Specification, any other governing entity's specifications, and applicable street cut policies, ordinances, or permits.

3.2.27. **Pipe Joint Restraint System**. Pipe joint restraints must be used to prevent movement for PVC push-on bell and spigot pipe connections. The restrainer may be adapted to connect a plain end PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. Joint restraint is to be non-directional and installed to fully restrain system. All pipe and fitting systems with restrained joints must be identified by applying an adhesive-backed warning tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes, the warning tape must be applied directly to the top of the pipe. For metal pipes and fittings the warning tape must be applied to the top of the polyethylene film wrap.

3.2.28. **Concrete Encasement, Cradles, Saddles and Collars**.

3.2.28.1. **Concrete Encasement**. When concrete encasement is shown on the plans or when directed, the trench is to be excavated and fine graded to a depth conforming to the details and sections shown on the plans. The pipe is to be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming to details and sections shown on the plans.

3.2.28.2. **Concrete Cradles**. When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described above. The cradle must be constructed in accordance with details and sections shown on the plans. Strap/Tie Downs must be No. 4 rebar diameter minimum or better as determined by the Water System Inspector.

3.2.28.3. **Concrete Saddles**. When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.3, "Backfill" of this specification to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

3.2.28.4. **Concrete Collars**. When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

3.2.29. **Fire Hydrants**. Hydrants are to be connected to the main as shown on the plans or as directed. They are to be installed in a manner which will provide complete accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb the hydrant barrel is to be set so that no portion of the hydrant will be less than 12 in. no more than 7 ft. from the back of the curb.

When the hydrant is set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line no portion of the hydrant or nozzle cap is to be within 6 in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the Contractor.

Hydrants are to be set in accordance with plans and details are to be set plumb and are to have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Drainage and concrete pad are to be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit is to be connected to a storm sewer or to a sanitary sewer.

Restrained Joints: Restrained mechanical joints that require field welding or groove cuts into the pipe barrel for restrain will not be accepted. Restrained joints must be furnished for pipe at all changes in direction at indicated on plans, details, or as directed. Restrained mechanical joints must be locked mechanical joints. Joints must be capable of test pressure twice the maximum sustained working pressure of 350 psi for ductile iron pipe and PVC.

Replacing and Relocating Existing Fire Hydrants: When existing fire hydrants are to be replaced or relocated, the work is to be accomplished by either of the following:

- Cutting or installing a tee of the size and type indicated on plans or as directed.
- Using a tapping sleeve and valve of the size and type indicated on plans to install a new fire hydrant to an existing or new water main. Size on size taps is not permitted.
- Relocating the existing fire hydrant by closing the existing fire hydrant, extending the fire hydrant branch, and installing the existing fire hydrant as specified herein.

Salvage the existing fire hydrant and other materials as designated in the field by the Construction Inspector and deliver to Water System material storage yard located at 3930 East Houston Street, San Antonio, Texas. Fire hydrant branches are to be abandoned by cutting and capping fire hydrant cast iron tee at the service main and surface restored to its original condition.

After the fire hydrant has been set, paint hydrant with suitable primer and finish with oil-based aluminum paint from top of hydrant to a point 18 in. to 20 in. below centerline of the pumper nozzle and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting is to be included in the unit cost for installing the fire hydrant.

Installation on Water Mains: Ductile iron pipe, cast iron and ductile iron fittings, and valves used in the placement of fire hydrants and connections to the main will be considered part of the fire hydrant installation and not a part of the main construction. No separate payment will be made for this pipe. Hydrants should be connected to the mains as shown in the contract documents or as directed. Hydrants must also be installed in a location where there is accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

3.2.30. **Gate Valves, Valve Boxes, Adjustments**. Gate valve installation should include valve, reaction blocking, cast iron boot, valve box extension (with ductile iron riser pipe), valve box, concrete collar (where subjected to vehicular traffic), and valve box lid. Gate valves constructed in the terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems, on all valves located between 6 ft. and 13 ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other area subject to vehicular traffic must be provided with concrete collars as shown in these standard drawings. When mixing concrete on site, contractor must ensure a quality product is used and should follow manufacturer mixing requirements. Any concrete deemed substandard by inspector will be replaced at no additional cost to owner. Collars around such valve boxes must be formed and finished off neatly and in a sound workmanlike manner.

Valve pits must be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box must be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits should be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact (where penetrating through pit walls).

In Pressure Zones 9—16, all valves 6 in. and larger must be supported on a concrete pad in accordance with details shown on the plans.

Existing valve boxes located within the limits of new street construction which are in conflict are to be adjusted to match proposed finish grades.

All valves outside of facilities should be open right.

3.2.31. **Air Release Assembly**. Air release valves and appurtenant items are to be installed at the locations shown on the plans unless otherwise directed.

Install air release assemblies in open trench in accordance with plans and details. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories, and appurtenances. It also includes service line and tap to main. Air release assemblies installed in parkways or easements and outside of street pavement must be installed in accordance with plans.

Air release assemblies installed on steel pipe attached to bridge structure includes the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories, and appurtenances.

3.2.32. **Blow-offs**. Permanent and temporary blow-off assemblies should be installed where shown on the plans or at locations designated by the Engineer/Owner and at the end of all dead end mains in accordance with the Texas Administrative Code (TAC) rules to include 30 TAC § 290.44 (d)(5), (6).

The permanent blow-off will consist of the following: all galvanized iron pipe, valve, and fittings of the various sizes shown on the plans, 6 in. valve box assembly and concrete collar around the valve box. The temporary blow-off will consist of the following; all galvanized iron pipe, valve and fittings of the various sizes shown on the plans. Valve box must be raised or installed to finished grade and installed in accordance with the details.

3.2.33. **Anchorage and Blocking**. Suitable reaction blocking or anchorage is to be provided at all dead ends, plugs, caps, tees, crosses, valves and bends as shown on the plans. All mechanical (joint) restraints are to be bidirectional. Anchor blocks are to be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust except where this is not possible as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be used in conjunction with blocking when shown on the plans or as directed.

Thrust blocking is to be a minimum of Class “A” (3,000 psi), concrete placed between solid ground and the fitting except as otherwise shown on the plans. The area of bearing in contact with solid ground is to be that shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in Pressure Zones 9 through 15 should be as shown on the plans. In all cases, the design of thrust blocking must be of enough size to withstand a soil pressure of 3,000 psf, unless specified otherwise in the job plans or specifications. The maximum soil lateral load bearing capacity that will be allowed for the design of thrust blocking must be 5,000 psf. When soil lateral load bearing capacities of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil is question should be submitted to the Engineer for verification.

The blocking is to be placed so that pipe and fitting joints will be accessible. Pipe polywrap is to be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee is to be poured separately from the block across the back of the tee. If they are poured simultaneously, a rigid partition is to be placed between the blocks.

Valves 12 in. and larger in size are to be supported on a concrete pad extending vertically from 12 in. below the bottom of the valve to the lower quarter point of the hub and laterally from face to face of hubs and transversely from wall to wall of the trench.

3.2.34. **Butterfly Valves**. Butterfly valve installation will include: butterfly valve, coated and wrapped steel pipe nipple with reaction stop ring, concrete reaction blocking, cast-iron boot, valve box extension (ductile iron riser pipe), valve box and lid, concrete collar where subjected to vehicular traffic, all couplings and all coupling adapters required to complete the connection. The entire valve, except for the operating nut, must be coated with an approved SAWS sewer structural coating, and wrapped with Polywrap. Butterfly Valves constructed in a terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems on all valves located between 6 ft. and 13 ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly and in a workmanlike manner.

3.2.35. **Reinforced Concrete Vaults**.

3.2.35.1. **Forms**. Forms should be designed to produce hardened concrete with the shape, lines, and dimensions shown on the plans.

Surfaces which will be exposed to view when construction is completed should be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. The forms must produce finished surfaces that are free from off-sets, ridges, waves, and concave or convex areas.

Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms and may be used as backing for form linings.

Before concrete is placed, a film of light form oil must be applied to the forms.

Forms should be substantial and tight to prevent leakage of mortar. Form must be thoroughly cleaned, braced, or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Form ties must be corrosion resistant and must have enough strength and rigidity to support and maintain the form in proper position and alignment.

3.2.35.2. **Form Removal**. Form must be removed after 24 hrs., provided that the exposed surfaces can be immediately and effectively sealed to prevent loss of moisture. Otherwise, the forms should remain in place for 48-hrs. Precautions should be taken in form removal to avoid surface gouging, corner or edge breaking, and other damage to the concrete.

3.2.35.3. **Reinforcing Steel**. Reinforcing steel should be accurately formed and must be free from loose rust, scale, and contaminants which reduce bond. Unless otherwise shown on the plans, bar reinforcement must be deformed and conform to the general requirements of Item 440, "Reinforcement for Concrete."

3.2.35.4. **Reinforcing Steel Placement**. Reinforcing steel should be accurately positioned on supports, spaces, hangers, or other reinforcements and must be secured in place with wire ties or suitable clips. All bars must be shop fabricated and bent cold.

3.2.35.5. **Concrete Placement**. Concrete should be placed as nearly as practicable in its final position to avoid segregation due to re-handling. When the concrete pour has commenced, it should be carried on as a continuous operation until the placing of the panel or section is completed as a whole. All concrete must be thoroughly compacted by suitable means during pouring operations and must be thoroughly worked around reinforcement bars and into the corners of the forms. Mechanical vibration or other acceptable means should be used to completely embed the reinforcement and eliminate honeycomb. Finished surfaces should be brought to proper grade, struck off, and completed in a workmanlike manner. No honeycombing, rough spots, or protruding stones should be left exposed.

3.2.35.6. **Curing**. Concrete must be protected from loss of moisture for at least 7 days after placement. Curing of concrete should be by methods which will keep the concrete surfaces adequately wet during the specified curing period.

3.2.35.7. **Water Curing**. Water saturation of concrete surfaces should begin as quickly as possible after the initial set of the concrete. The rate of water application should be regulated to provide complete surface coverage with a minimum of runoff.

3.2.35.8. **Membrane Curing**. Chlorinated, rubber-type, membrane curing compound may be used instead of water curing on concrete which will not be covered later with mortar or additional concrete. Membrane curing compound should be spray applied at coverage of not more than 300-sq. ft. per gal. If forms are removed before the end of the specified curing period, curing compound must be immediately applied to the formed surfaces before they dry out.

Curing compound should be suitably protected against abrasion during the curing period.

3.2.35.9. **Finishing Surfaces**. Fins and other surface projections should be removed from all formed surfaces. All exposed exterior surfaces should have a rubbed finish. The floor surface should be brush finished, unless otherwise specified.

3.2.35.10. **Repairing Defective Concrete**. Defects in formed concrete surfaces must be repaired to the satisfaction of the Engineer within 24 hr., and defective concrete must be replaced within 48 hr. after the forms have been removed. All concrete which is honeycombed or otherwise defective should be cut out and removed to sound concrete with edges square cut to avoid feathering.

Concrete repair work should be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work must be adequately cured.

3.2.35.11. **Painting**. All exposed metallic surfaces such as the cover plate, hinges, handles, and other exposed hardware, must be primed and painted with one coat of primer and one coat of aluminum paint of approved and compatible quality.

3.2.35.12. **Backfill**. The Contractor should cover the openings at each end of the vault with 1/4 in. plywood placed outside the vault. Selected backfill (consisting of job excavated materials, finely divided and free from debris, organic material, and stones larger than 2 in. in greatest dimension) must be placed in uniform layers not exceeding 8 in. in uncompacted thickness and must be carefully compacted around the sides of the vault until level with the surrounding ground.

3.3. **Backfill**.

3.3.1. **General**. Trenches must not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, only the secondary backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials, free from large clods of earth or stones. Where pipe is specially coated, sleeve wrapped, or tape wrapped for protection against corrosion, care should be taken not to damage the coating, sleeve wrap, or tape wrap.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section must be excavated to the depth of properly compacted soil and a length 50 ft. beyond the failed area, then refilled and compacted to the grade and compaction level required. The use of sand backfill will not be allowed. All compaction within the secondary backfill zone will be such that the apparent dry density of each layer must be not less than 98% from the top of the initial backfill to the bottom of pavement section. The pavement (asphalt) section must have 95% compaction density with a maximum dry density at + or – 2% optimum moisture content as determined by tests on samples as outlined in the latest provisions of Department Testing Method Tex-113-E or most applicable approved equal provisions, unless otherwise shown on the contract documents. At the time of compaction, the water content must be at optimum moisture content, + or - 2% points.

3.3.2. **Initial Backfill**. Initial backfill is defined as backfill with a thickness in its compacted state from the surface of the bedding to a point 1 ft. above the top of pipe. The first lift of initial backfill is to be inspected and approved before placement of the second lift. The second lift of initial backfill material is to extend from the spring line of the pipe with a minimum of 1 ft. above the top of the pipe. The second lift is to be evenly spread in a similar manner as the first lift.

For diameters 24 in. and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12 in. lifts to a minimum of 1 ft. above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3 ft. on each side of pipe.

3.3.3. **Secondary Backfill**. Secondary backfill is defined as backfill from 1 ft. above the top of pipe to the top of the trench or bottom of pavement section. Secondary back fill is to be constructed in accordance with details shown on plans and these specifications.

Secondary backfill material should be placed in maximum 12 in. loose lifts or as directed.

3.3.4. **Sand Backfilling of Cross Trenches and Open Holes**. Blow-offs, tie ins, air release valves, and service lines, meter boxes, or other specials are to be backfilled with sand and thoroughly consolidated by saturating with water, unless otherwise directed. The use of mechanical tamping equipment for compaction of backfill will not be permitted at such locations. Disposal of surplus excavated material and placement of sand is to be included in the trenching and backfilling and will not be paid for directly.

3.3.5. **Trench Backfill Across Traffic Arteries**. Any trench in or across traffic arteries is to be backfilled immediately after the pipe is installed unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.3.6. **Flowable Backfill**. Instead of normal backfill materials, the Contractor is to backfill the trench with flowable backfill with fly ash material at the locations shown on the plans or at locations directed. The flowable backfill material and operation are to be in accordance with Item 401, “Flowable Backfill.”

3.4. **Flushing and Testing Mains**.

3.4.1. **Flushing**. Immediately upon completion of water main work, the Contractor must flush all mains affected by the scope of the work. This flushing will consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through should continue until it is determined all dust, debris, or foreign matter that may have entered during pipe laying operations has been flushed out. All new mains must then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses should be used to direct flushing water from the main into suitable drainage channels or sewers. The Contractor is to coordinate with the Inspector before flushing.

3.4.2. **Operation of Valves**. No valve in the distribution system is to be operated by the Contractor without prior permission of the Inspector. The Contractor must notify the Inspector when a valve is to be operated and must only operate the valve in the presence of the Inspector.

3.4.3. **Hydrostatic Tests**. After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a hydrostatic pressure followed by a leakage test will be performed. All new mains must be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer or Inspector. It is the intent of these Specifications that all joints be watertight and that all joints which are found to leak by observation during any test must be made watertight by the Contractor. When repairs are required, the hydrostatic field test must be repeated until the pipe installation

conforms to the specified requirements and is acceptable to the Engineer/Inspector. The Contractor must ensure that the Engineer/Inspector be present for the duration of the pressure test.

3.4.4. **Test Procedures**. After the new main has been laid and backfilled as specified, but before chlorination and replacement of pavement, it is to be filled with water for a minimum of 24 hr. and then subjected to a hydrostatic pressure test.

The specified test pressure is to be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters are to be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and making tests through existing mains. Before applying the specified test pressure, all air is to be expelled from the main. To accomplish this, taps are to be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the Department. At intervals during the test, the entire route of the new main is to be inspected to locate any leaks or breaks. If any are found, they are to be stopped or repaired. The test is to be repeated until satisfactory results are obtained. The hydrostatic test is to be made so that the maximum pressure at the lowest point does not exceed the specified test pressure.

The duration of each pressure test is to be a minimum of 4 hr. for new mains in excess of 1,000 ft. and a minimum of 1 hr. for new mains less than 1,000 ft. after the main has been brought up to test pressure. The test pressure is to be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests are to be continued until the Engineer is satisfied that the new main meets the requirements of these specifications.

Should any test of pipe in place disclose leakage greater than listed in Table 16, Hydrostatic Test Leakage Allowances, the Contractor is to, at his expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valve section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor is to notify the Engineer before beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

Table 16
Hydrostatic Test Leakage Allowance (Max) @ 200 psi

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons Per Hr. (gph)2									
	100 FT.	200 FT.	300 FT.	400 FT.	500 FT.	600 FT.	700 FT.	800 FT.	900 FT.	1000 FT.
6” DI1	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8” DI1	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12” DI1	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16” DI1	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20” DI1	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
20” CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79
24” DI1	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
24” CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30” DI1	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
30” CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36” DI1	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36” CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42” DI1	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42” CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48” DI1	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19
48” CSC	0.19	0.38	0.70	0.76	0.95	1.13	1.32	1.51	1.70	1.89
54” CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
60” CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30

Nominal Diameter and Pipe Material	Allowable Leakage in Gallons Per Hr. (gph)2									
	100 FT.	200 FT.	300 FT.	400 FT.	500 FT.	600 FT.	700 FT.	800 FT.	900 FT.	1000 FT.

1. PVC pipe must be tested to DI pressures. DI Pipe includes mechanical and push-on joints.
2. GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

3.5. **Disinfection of New Mains Utilizing Machine Chlorination**. After the new mains have successfully passed the pressure test specified in Section 3.4.3, “Hydrostatic Tests,” the San Antonio Water System will disinfect those mains shown on the plans or otherwise indicated as “Machine Chlorination.” This disinfection is to include chlorination, flushing, and placing the mains in service. All other disinfection requirements must be accomplished by the Contractor. Disinfection by the Contractor is limited to sections of pipe less than 800 ft. in length between sections.

3.5.1. **Operation of Valves**. During and after disinfection of mains less than or equal to 16 in. in diameter, the Contractor must be notified by the Inspector sufficiently in advance (2 work days) to enable the Contractor to have a competent representative present whenever valves are to be operated that will affect the pressure in any part of the work for which the Contractor is responsible.

3.5.2. **Contractor's Personnel and Equipment**. The Contractor is to supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.5.3. **Safeguarding and Backfilling Open Holes**. The Contractor is to be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor is to backfill such holes in accordance with appropriate provisions of Section 3.3, “Backfill.”

3.5.4. **Disinfection of Mains Utilizing Dry Calcium Hypochlorite**. Mains are to be disinfected with dry Calcium Hypochlorite (HTH) where shown on the plans or as directed and must not exceed a total length of 800 ft. This method will also be followed for main repairs. Contractor must use appropriate safety measures to protect personnel during disinfection operation.

3.5.5. **Dosage**. The Contractor is to disinfect the new or replaced mains with Calcium Hypochlorite (HTH) of 70% available chlorine. Calcium Hypochlorite (HTH) is to be used to obtain a minimum chlorine concentration of 50 ppm. The following Table 17, Chlorine Dosage, is included for the convenience of the Contractor:

Table 17
Chlorine Dosage

Diameter of Pipe In.	oz./ft. To Obtain 50 ppm Chlorine Dosage
6	0.0138
8	0.0233
10	0.0364
12	0.0523
14	0.0708
16	0.0934
18	0.1175
20	0.1455
24	0.2080
30	0.3270
36	0.4690
42	0.6370
48	0.8330
54	1.0575
60	1.308

A heaping tablespoon holds approximately 1/2 oz., and a standard measuring cup holds approximately 8 oz.

3.5.6. **Filling the Main**. Those sections of main to which dry Calcium Hypochlorite (HTH) has been applied is to be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves is to be under the direction of the Engineer in accordance with Section 3.5.1, "Operation of Valves."

3.5.7. **Holding Time**. The length of time that sections of main disinfected with Calcium Hypochlorite (HTH) is to be allowed to stand undisturbed will depend upon the particular job and Texas Commission on Environmental Quality (TCEQ) criteria.

- When circumstances permit a shutdown with no customers out of service, the required minimum detention time will be 24 hr. with a 50 ppm chlorine dosage.
- When customers are out of service during a shutdown with no leakage past valves, the required minimum detention time will be 3 hr. and the chlorine dosage will be 300 ppm.
- When customers are out of service during a shutdown with some leakage past valves, the required minimum detention time will be 30 min. with a 500 ppm chlorine dosage.

3.5.8. **Flushing**. Following the expiration of the specified holding time, the treated section of main is to be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 3.4, "Flushing and Testing Mains." Flushing is to continue until no chlorine remains detectable by taste or odor or until the chlorine residual is less than 0.3 ppm. The Contractor must make provisions for the disposal and runoff of the flushing operations to minimize erosion or impact to residents.

3.5.9. **Preventing Reverse Flow**. Valves are to be manipulated so that the strong chlorine solution in the line being treated will be flushed out of the main and will not flow back into the line supplying the water.

3.5.10. **Supervision**. All disinfection is to be done as is done under the general supervision of the San Antonio Water System.

3.5.11. **Additional Treatment**. Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment is to be as directed. If further disinfection is required, chlorination is to be done in accordance with Section 3.5, "Disinfection of New Mains Utilizing Machine Chlorination." In no case, however, is the new line to be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the Standards of the TCEQ.

If an open hole is unsafe and does not have proper trench protection, owner's chlorination crew will not chlorinate project until acceptable trench protection is provided.

3.6. **Service Supply Lines**. Service supply lines and fittings, meter boxes and appurtenances must conform to material specifications and must be installed by the Contractor as specified herein, or as directed and in accordance with plans. Service supply lines in High Pressure Zones should be installed with two strap service saddle clamps.

3.6.1. **Designation of Service Supply Lines**. A service supply line located between the Water main and the inlet side of the water meter is designated as a "water service line." A service supply line located between the outlet side of the water meter to the point of connection within the limits of the Customers lot or property is designated as "Customer's yard piping." Services 2 in. and smaller are designated "small services"; services 4in. and larger are designated "large services."

3.6.1.1. **Service Relays**. New transfer mains to which services are to be relayed and are on the same side of the streets as the Customer's meter are defined as "short relays." New transfer mains to which services are to be relayed and are on the opposite side of the street from the Customer's meter are defined as "long relays."

3.6.1.2. **Service Reconnects**. New transfer mains to which services are to be reconnected and on the same side of the street as the old main are defined as "service reconnects." Existing services on the opposite side of the street to the new main will be defined as a "long reconnects."

3.6.1.3. **Service Relocates**. Service Relocates are defined as services that are relocated from an alley to a side or front street. New transfer mains to which services are to be relocated and are on the same side of the street as the Customer's new meter box location, are designated as "short relocates." New transfer mains to which services are to be relocated and are on the opposite side of the street from the Customer's new meter box location, are designated as "long relocates."

3.6.1.4. **New Services**. If a new main is required to be extended to provide water service for new Customers, the service lines laid to the new main will be designated as "new services." New laid mains to which new services are on the same side of the street as the Customer's new meter box location, are designated as "new short services." New laid mains to which new services on the opposite side of the street from the Customer's new meter box location, are designated as "new long services."

3.6.1.5. **New Un-metered Services**. New Un-metered services are defined as services that are installed on existing mains or new mains to provide service to Customers platted vacant lots. Where the new main or existing main to which new un-metered services are being installed is on the same side of the street as the Customer's new or existing meter box location, (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated "new un-metered short services." Where the new main or the existing water main to which new un-metered services are installed is on the opposite side of the street from the Customer's new or existing meter box location (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated "new un-metered long service." New un-metered long services and new un-metered short services will not include "Customer's yard piping" and no meter will be set.

3.6.1.6. **Tap Holes**. Tap holes are defined as excavations at existing mains, which are required in association with replacements of water service lines by pulling, boring, or jacking operations.

All backfill material will be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill and secondary backfill will be included in the various sizes of each service placed.

3.6.1.7. **Service Line Installation**. Unless otherwise notified, service relays, service reconnects, service relocates and new services will be installed as described herein, and in plans. Unless otherwise indicated, existing meter and meter box relocation will be included in the service line installation.

All service line installation will include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown in plans.

Cutting, excavation, backfill and replacement of pavement will be done as specified herein and in accordance with applicable sections of this specification and the contract documents. The minimum trench width for small service lines will be 8 in., while the minimum trench width for large service Lines will be the nominal pipe diameter plus 16 in., except when specified otherwise by the Engineer. For 3/4 in. to 2 in. service lines, minimum bury depth will be 3 ft. For services greater than 2 in., minimum depth of bury will be 4 ft.

All service lines should be installed in accordance with plans, and specifications, except that two strap service saddle clamps must be installed for all tap connections made on water mains located within boundaries of Pressure Zones (formally known as Service Levels) 9 through 16.

The Contractor must use precaution to protect and preserve the polyethylene wrap around Ductile-Iron (DI) water mains when installing service corporations. The required method is, wrap pipe tape around the pipe, over the polywrap, in the area to be tapped. The tap should be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation and the first 3 ft. of the service, must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8 in. above the main.

Small service lines must be embedded in sand in accordance with specification.

When approved by the Construction Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor must isolate the new service line by closing the curb stop or angle valve until the meter box is set.

3.6.1.8. **Splicing**. A long service line single splice may be permitted by means of a three part compression or flared coupling only when approved in advance by the Engineer, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

3.6.1.9. **Boring or Jacking Service Lines**. Service lines which cross paved streets may be installed at the Contractor's option by boring or jacking operations. Where it becomes necessary to widen the main trench section to accommodate a bore pit, such widening must not extend more than 1 additional ft. into the traffic side of the street.

3.6.1.10. **Tapping Asbestos Cement (AC) Water Mains**. All necessary service line tapping of AC pipe must be completed during the period immediately before or after hydrostatic pressure testing operations so that subsequent flushing will maximize the elimination of contaminants associated with the tapping process. Direct tapping will not be allowed. Service saddles must be used when tapping AC pipe. Drill tools should be used for services less than 2 in. shell type drills should be used for all services 2 in. and greater.

Tapping of AC pipe must be done in accordance with manufacturers' recommendation and done only with tap machine with a built in flush valve and the flush valve must be open during the entire procedure.

3.6.1.11. **Abandonment of Service Lines**. The Contractor should accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated on the plans as "tap plug" and "tap kill." The corporation stop for an abandoned service line tapped on a ferrous main must be removed, and the tap at the main must be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop must not be removed from the main. Instead, the corporation stop must be closed and the flared nut should be removed from the corporation stop. After the appropriately sized copper disc is inserted inside the flared nut, replace the flared nut on the corporation stop. The Contractor should salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the Owner.

3.6.1.12. **Tapping PVC C 900**. Tapping of PVC must be done in accordance with Uni-Bell procedures. Direct Tapping will not be allowed. All drill cutting tools must be the "shell type" with internal teeth or double slots which will retain the coupon. The shell cutters must be designed for C900 pipe, thus with enough root depth to handle the heavier walled pipe.

3.6.1.13. **Small Service Lines**. Copper tubing, HDPE or PEXa tubing listed on the SAWS Approved Products List should be used for 3/4 in. through 2 in. service lines. Brass fittings for 3/4 in. and 1 in. service lines should be of the flared or compression type for the use with Type “K” soft annealed copper tubing. Brass fittings for 1.5 in. and 2 in. lines should be of the flared or compression type for use with Type “K” soft annealed copper tubing, except as modified by this specification.

Copper tubing must be cut squarely by using an approved cutting tool and by avoiding excessive pressure on the cutting wheels which might bend or flatten the pipe walls. Following the copper tubing cut, but before flaring, a reamer should be used to remove the inside rolled lip from the tubing. Flared ends should be expanded by the use of a flaring tool using care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings must be straight for at least 10 in. Bending of tubing should be accomplished by using an appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section should be cut out and replaced. When compression fittings are used, the copper tubing should be cut squarely before insertion into the fitting Final assembly must be in accordance with the manufacturers' recommendations.

3.6.1.14. **Small Service Lines on New Mains**. Installation of new copper, HDPE or PEXa service lines will consist of all excavation through miscellaneous material encountered; trench excavation protection; drilling and tapping the new main with an approved tapping machine; setting the curb stop or angle valve at the meter; laying the new copper service line at the specified depth between the main and the meter and its tie in at the corporation and the curb stop or the angle valve; relocating the existing meter and installing a new meter box where required in accordance with this specification, herein; backfilling the trench with approved selected material and disposal of surplus excavated material; capping the tap hole with asphalt treated base, including the outer limits of the main trench line with service line trench; cutting and replacing pavements, curbing and sidewalks of all types over the limits of the main line trench and the completed service line trench.

3.6.1.15. **Reconnecting Service Lines**. Both old and new water mains at existing service line connections as shown on the plans must be exposed. The old main must be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main must be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose enough length of the existing service line to provide slack to bend it to position for tying to the new corporation stop. After suitable notification to the Customer, the Contractor should “kill” the existing service by closing the corporation stop, removing the existing flare nut, inserting the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous. The Contractor must then immediately open the stop and restore water service to the Customer. Where it is not possible to obtain enough length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor must splice the necessary length of new tubing and tie it to the existing service by means of a compression coupling at a point as close as practicable to the new main.

Cutting and bending of the tubing, introduction of slack to compensate for soil movement, and completion of the installation will be as specified herein.

Where old and new mains are on opposite sides of the street, service lines may be installed under the street pavement by boring rather than trenching.

3.6.1.16. **Relaying Service Lines**. The existing or new mains shown on plans must be exposed opposite location stakes placed on site at the direction of the Engineer. The existing or new main should be drilled and tapped with an approved tapping machine, a new corporation stop installed, and the trench extended laterally to the location specified for the meter box. The existing meter must be reset and the meter box and base must be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location should not vary more than 24 in. in any direction from its staked location. The service line must be installed with enough slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line should be extended from the main to the existing meter, a new curb stop installed at the end of the service line, and connected to the inlet side of the meter. If disturbed, the existing meter box must be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching.

3.6.1.17. **Single Service Line - Dual Meters**. The single service line - dual meter installation will consist of a 1 in. copper, HDPE, or PEXa service line reducing to two 3/4 in. copper, HDPE, or PEXa service lines at a tee which should be set in line with the front edge of meter boxes for 5/8 in. and 3/4 in. meters. A single service line with dual meters should be installed in those new residential developments where new 5/8 in. and 3/4 in. meters are required and in main replacement work where it is necessary to change the location of existing 5/8 in. and 3/4 in. meters. Single service line - dual meter materials and installation requirements must conform to requirements established herein.

3.6.1.18. **Small Service Lines on Existing Mains**. The work involved in the installation of new copper, HDPE, or PEXa service lines on existing mains will consist of jacking, boring, tunneling, and, where authorized, open trench operations all excavation through whatever material encountered; trench excavation protection; using the existing corporation when approved by the Engineer; tapping the existing main and installing the new corporation and setting the curb stop or angle valve at the meter; relocating the existing meter and installing a new meter box where required in accordance with this specification; abandoning the existing corporation

stop, removing the existing flared nut, inserting inside the existing flared nut an appropriately sized copper disc and replacing the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous; installing the new service line at the same grade as the existing service line or at the specified grade between the main and the existing meter and its tie in at the corporation and the curb stop; disposal of surplus excavated material; capping the tap hole with asphalt treated base including the outer limits of the main line trench and the service line trench; cutting and replacing all surfaces of whatever type encountered over the completed service line trench; restoration of the site.

3.6.1.19. **Large Service Lines**. DI pipe and cast-iron fittings used for metered service lines and non-metered fire service lines larger than 2 in. must be installed in accordance with the applicable provisions of this specification, except where otherwise approved by the Engineer.

3.6.1.20. **Large Service Lines on New Mains**. Work involved in the installation of a new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered; trench excavation protection, installing tees, pipe and fittings of various sizes including main line and service line valves, valve boxes, DI pipe, fittings, in accordance with plans and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.6.1.21. **Large Service Lines on Existing Mains**. The work involved in the installation of the new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered, trench excavation protection, cutting in tees and installing tapping sleeves and valves, pipe and fittings of various sizes including main line and service valves; valves boxes, DI pipe, fittings and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.6.2. **Meter Boxes**. Physical movement of existing meters and meter boxes to new locations may be required where service lines are transferred to new mains in conjunction with main replacement work. Unless specified otherwise, the Contractor should move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC Schedule 80 must be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers should be salvaged and returned to the Owner by the Contractor. The Contractor must also replace the salvaged meter boxes with the new, appropriately styled oval plastic meter box with oval cover, or rectangular meter box. Unless otherwise specified, the old service line should be abandoned after the existing meter has been reset in the existing or new meter box.

Where meter boxes are installed in sidewalks or driveways, the Contractor should install a number one meter box (2 pieces) as shown on plans.

New meters will be set by the Owner where mains are extended and new services lines are installed for new or initial customer service. Instead of the new meter, the Contractor should furnish and install a meter template in accordance with plans.

Meter and meter box configuration should have the meter set horizontal, approximately 6 in. below the top of meter box, so that the meter is above the bottom of the meter box and in line with the meter box lid opening. The top of the meter box should be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box should be removed so that the meter register is clearly visible. The Contractor must exercise special precautions during excavation at the existing meter location to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor must raise the existing meter to conform to the correct configuration indicated herein.

Adjustment of meter to proper grade will not be paid for separately.

Where required, pressure reducing valves should be installed by the customer in accordance with the Uniform Plumbing Code and must be placed beyond the outlet side of the meter, but not within the Owner's meter box. The pressure reducing valve will be the property of the water user who will be responsible for its installation, maintenance, and replacement as required.

The meter box adjustment must not exceed 10 ft. from the existing box.

3.6.3. **Water Service for Fire Lines**.

3.6.3.1. **Start of Work**. Three working days' notice will be given to the assigned Inspector before start of a project after permit has been issued. The Contractor must start his work at a tie in or point designated by the Engineer. Pipe must be laid with bell ends facing in the direction of laying, unless otherwise authorized or directed by the Engineer. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations. Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed. No valve or other control on the existing system should be operated for any purpose by the Contractor unless a representative of the San Antonio Water System is present.

3.6.3.2. **Crossing Other Underground Lines**. New fire line services crossing any other utilities must have a minimum of 48 in. of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities must be done by hand for at least 12 in. all around. Any damage to other utilities must be reported to the governing entity/owner of said utility as well as the Inspector.

3.6.3.3. **Pipe Grade**. Fire line services must have a minimum of 48 in. of cover for mains 16 in. and below, and 60 in. for mains 20" and above, over the top of the pipe unless otherwise waived or modified by the Engineer. Pipe grades must be as required by the plans or as directed. Grades must be met as specified. Precautions must be taken to ensure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length except at couplings. Couplings should not be in contact with the original trench bottom before backfilling. Modified Grade 5 material should be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade should be made only at joints.

3.6.4. **Modified Grade 5 Materials**. Before placing pipe in a trench, the trench should have been excavated to the proper depth as required herein. Approved imported materials or Engineer approved materials selected from suitable fines derived from the excavation should be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.6.5. **Structures to Support Pipe**. When either the Inspector or Engineer note that the material at the bottom of a trench is unstable or unsuitable, and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade should be over-excavated, with approved material, and properly compacted in place to provide a suitable base to support the pipe. If it is determined by the Engineer that this method cannot be used to stabilize the trench subgrade, the Contractor should then construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. Coordinate with Engineer for approval of extra compensation before beginning work.

3.6.6. **Lowering Materials into Trench**. Proper implements, tools, and facilities satisfactory to the Engineer must be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water service materials and protective coatings and linings. Under no circumstances should water service materials, pipes, fittings, etc., be dropped or dumped into the trench. Extreme care must be taken to avoid damaging polywrap films. No chains or slings should be allowed unless the entire sling is wrapped with a protective nylon web sock.

3.6.7. **Laying of Pipe**. Every precaution must be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions, work stoppage for more than 24 hr. or as otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign material from entering the pipe. The cap/plug must be left in place until a connection is made to the adjacent pipe. The interior of each pipe must be inspected for foreign material or defects, and the pipe must be cleaned or rejected if any foreign debris or defects are found, respectively.

After placing a length of pipe in the trench, the jointed end should be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements herein. The pipe should be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow enough and uniform space for joints will be rejected by the Engineer or Inspector and must be replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is halted, the open end of pipe in the trench must be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be joined must be capped or plugged at each end to make it watertight. This provision will apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal must remain in place until the trench is pumped completely dry. The Contractor must provide all plugs and caps of the various sizes required.

3.6.8. **Deviations in Line or Grade**. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to an extent that an alteration in the plan is required, the Construction Inspector will have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. Any deviation from the line should be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Construction Inspector. These deviations must be clearly and accurately reflected in the Contractor's submittal of redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed by the Construction Inspector and as described herein. In no case should the amounts exceed those shown in Table 18 "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe.

Table 18
Max Deflections of Ductile-Iron Pipe

Nominal Pipe Diameter	Max Deflection Angle	Max Deflection (in.)		Approximate Radius of Curve (ft.)	
		18 ft.	20 ft.	18 ft.	20 ft.
6"	4°25'	16.7	18.5	234	260
8"	3°51'	14.6	16.2	268	297
10"	3°42'	14.0	15.5	279	310
12"	3°08'	11.9	13.2	327	363
16"	2°21'	8.8	9.7	440	488
20"	1°55'	7.2	8.0	540	600
	1°35'	6.0	6.7	648	720

3.6.9. **Cutting Pipe**. The cutting of pipe for inserting valves, fittings, or closure pieces must be accomplished in a neat manner so as to produce a smooth end at right angles to the axis of the pipe. The recommendations of the pipe manufacturer should be strictly followed by the Contractor. Only qualified and experienced workmen must be used and, under no circumstances, should a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

3.6.9.1. **Asbestos-Cement (AC)**. No field cutting, breaking, or crushing will be allowed on AC pipe. Installation of fire line services to AC pipe mains must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings.

All cuts made on ductile-iron pipe must be done with a power saw. The cuts should be made at right angles to the pipe axis and must be smooth. The edges of the cut must be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of

about 30°. Solid sleeves or cast couplings must be allowed on precast/prefab vaults only. All other fire line services should be installed with full joints of pipe.

To facilitate future repair work on water mains, no sections less than 3 ft. in length between fittings will be allowed.

3.6.10. **Joint Assembly**.

3.6.10.1. **Rubber Ring Joints**. The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe must conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" will not be permitted. Spigot ends of pipe must be properly inserted in the joint by means of suitable pushing/pulling devices or a manufacture approved method.

3.6.10.2. **Mechanical Couplings**. Mechanical couplings must be assembled and installed according to the standards recommended by the manufacturer.

Mechanical coupling consists of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring is flared at each end to receive the wedge-shaped gasket which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts should be drawn up finger tight. Uniform pressure on the gaskets should be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning should be accomplished with a torque wrench and in a matter similar to the tightening procedure after 15 min.

3.6.10.3. **Restrained Joints**. Restrained Joints should be installed as shown on the plans or as directed by the Construction Inspector. Installation must conform to the manufacture’s recommendations.

3.7. **Installation of the Nonmetallic Pipe Detection System**. The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire will be used for location purposes and taped directly to the pipe. The tracer wire must be solid core (14 gauge insulated) and should be taped to the main in 10 in. increments. Wire should also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector.

3.8. **High Pressure Zone**. Work performed for construction of a high pressure water distribution system, including water mains, services, fire hydrants, and all related appurtenances, is to be done in accordance with this specification. This Section applies solely to the construction of high pressure water systems and will govern when in conflict with of sections of this specification.

3.8.1. **High Pressure Systems**. Each water distribution system that furnishes water in Pressure Zone 9 through Pressure Zone 14 will be designated as a high-pressure system. The static water pressure in each Service Level must be not less than 40 psi nor exceed 175 psi with no fire hydrants in use.

3.8.2. **Locations of High-Pressure Levels**. Geographically, boundaries of Pressure Zones 9 through 14 conform to the surface contour tabulation shown in Table 19. Most of the area within Pressure Zones 9 through 14 is located north of Loop 1604 between IH 35 North and Bandera Road.

Table 19
Pressure Zone Surface Contour Tabulation

Historical Name	Pressure Zone 2024	Ground Elevation 40 psi (ft.)	Ground Elevation 150 psi (ft.)
9	1,125	1,033	778
10	1,258	1,166	911
11	1,400	1,308	1,053
12	1,610	1,518	1,263
14	1,725	1,633	1,378

3.9. **Recycled Water System**. The installation of any recycle water system components will be done in accordance with these Specifications, except as otherwise noted. Recycled Water mains must also be installed at the TCEQ required separation distance between sewer and water mains as required by Texas Administrative Code (TAC) rules to include: The latest provision of 30 TAC § chapters 210, 290, and 217, or most applicable approved equal provision.

3.10. **Grouting of Water Mains**. Abandoning and grouting of water lines must not occur until all existing water mains and services have been transferred to a relocated water line or another line as designated in the Contract Documents. The Contractor will be responsible for the satisfactory coordination of the pipe abandonments with other construction and activities in the area. Delays in work resulting from lack of coordination will not be cause for additional compensation. Any work involving or impacting asbestos concrete pipe must be in accordance with the specifications.

Remove all water line appurtenances, such as hydrants, valves and valve casing and castings. Return these appurtenances to the designated utility representative or dispose of properly. Make cuts, install bulkheads, vents to allow for air release. Remove any free standing water before starting grout placement.

Place grout/flowable fill using concrete or grout pumps capable of continuous delivery at planned placement rate to fill volume between placement points not to exceed 500 ft. at a time. Pump grout/flowable fill through bulkheads constructed for placement of PVC pipes or other methods to contain grout in line to be abandoned. These pipes will be used for injection points or vents during placement. Place grout/flowable fill under pressure into properly vented open system until grout emerges from vent pipes indicating pipe is completely filled. Pumping must be completed under enough pressure to overcome friction and to fill water main from downstream to upstream end. Remediate areas where grout/flowable fill did not fill voids in water main by pressure grouting from inside water main or from surface if necessary. Plug each end of the water main being abandoned. Ensure that concrete is placed around plug/bulkhead and around pipe including bedding area, such that it is not penetrable by groundwater and that bedding at this location is not a conduit for groundwater. The method of installation must be able to meet the requirement of completely filling the existing water main and any voids adjacent to it.

Backfill to grade above pipe left in place. Place and compact backfill in compliance with Section 3.3 “Backfill.”

Remove, transport, and dispose of spoils. Spoils including pipe, unused grout/flowable fill and other unsuitable materials must be hauled to a facility permitted to accept the material. The abandonment method should provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they will be a part of the abandonment project process. The method should provide for the isolation of water mains to be grouted from water mains that are abandoned in place without grouting as shown on the plans.

Water mains that are not under proposed pavement are generally not required to be grouted unless it is specified in the contract documents. Mains to be abandoned should be grouted only if required by the contract documents and payment as per these specifications is provided.

3.11. **Cutting and Replacing Concrete Sidewalk, Driveway, etc.** The Contractor will cut and replace concrete sidewalks, driveways, etc. per the plans.

3.12. **Cutting and Replacing Concrete Sidewalk (Asphalt)**. The Contractor will cut and replace concrete asphalt sidewalks per the plans.

3.13. **Cutting and Replacing Asphalt Pavement**. The Contractor will cut and replace asphalt pavement per the plans.

3.14. **Cutting and Replacing Concrete Curb**. The Contractor will cut and replace concrete curb per the plans.

3.15. **Cutting and Replacing Asphalt Pavement with 6 in. Asphalt Treated Base**. The Contractor will cut and replace Asphalt Pavement with 6 in. Asphalt Treated Base, per the plans.

3.16. **Remove Existing Water Lines**. Contractor must be responsible for locating all water mains to be removed.

When specified or shown otherwise in the Contract documents, Contractor must remove the water main and all related appurtenances that are to be replaced, or will no longer be in service, and all effort to accomplish this requirement including but not limited to coordination, potholing, excavation and backfill with native or select soil, dewatering of pipe, groundwater dewatering, trenching, backfill and surface restoration, cutting, capping, removal of pipe, disposal of materials and all other items will be considered subsidiary to the work required.

4. MEASUREMENT

4.1. **Water main installed as "Pipe Water Main (DI)," "Pipe Water Main (PVC)," "Pipe Water Main (CSC)," "Pipe Water Main (PVC Casing) (Open Cut)," or "Pipe Water Main (Steel Casing) (Open Cut)."** Water main installed as "Pipe Water Main (DI)," "Pipe Water Main (PVC)," "Pipe Water Main (CSC)," "Pipe Water Main (PVC Casing) (Open Cut)," or "Pipe Water Main (Steel Casing) (Open Cut)" for water pipe of the various sizes shown on the plans, will be measured by the foot as follows:

- From the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run,
- between the centerline intersections of runs and branches of tees, and where the branch is plugged for future connection,
- the measurement will include the entire laying length of the branch or branches of the fitting,
- the measurement of each line of pipe of each size will be continuous and is to include the full laying lengths of all fittings and valves installed between the ends of such line except that the laying lengths of reducers will be divided equally between the connected pipe sizes,
- lines leading to a tapping connection with an existing main will be measured to the center of the main tapped, and
- excavation and installation of the nonmetallic pipe detection system will not be measured for payment.

4.2. **Fire Lines**. "Fire Lines" will be measured by the foot for each size and type from the centerline intersection of the fire line with the main distribution line to the property line. The measurement will include the entire laying length of the branch or branches of the fitting and valves. Line leading to a tapping connection with an existing main will be measured to the center of the main tapped.

4.3. **Water (Jacking, Boring or Tunneling)**. "Water (Jacking, Boring or Tunneling)" will be measured by the foot of bore or tunnel as measured from face to face of jacking pits.

4.4. **Carrier Pipe used in Bores and Tunnels or Jacked into Place**. Carrier pipe used in bores and tunnels or jacked into place will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.

4.5. **Carrier Pipe Installed in Open Trenches**. Carrier pipe installed in open trenches, where required by the plans, will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.

4.6. **Casing or Liners Used in Bores and Tunnels**. Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.

4.7. **Casing Installed in Open Trenches**. Casing installed in open trenches, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.

4.8. **Butterfly Valve and Box (Complete)**. "Butterfly Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.

4.9. **Gate Valve and Box (Complete)**. "Gate Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.

4.10. **Tapping Sleeve, Valve and Box (Complete)**. "Tapping Sleeve, Valve and Box (Complete)" will be measured as each assembly of the various sizes installed.

4.11. **Cut in Tee (Complete)**. "Cut in Tee (Complete)" will be measured by the unit of each such assembly of the various sizes of tee installed.

4.12. **Adjust Valve Box**. "Adjust Valve Box" will be measured as each assembly adjusted to correspond to finish grade.

4.13. **Removal Transport and Disposal of AC**. "Removal Transport and Disposal of AC" will be measured by the unit linear foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for contractor's information only and the work will be performed by a third party contractor as per Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

4.14. **Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars**. "Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" for pipe will be measured by the cubic yard of accepted work. Reinforcing, if required, will not be measured for payment.

4.15. **Fire Hydrant Assembly**. "Fire Hydrant Assembly" will be measured as each fire hydrant assembly installed. Also included will be enough pipe, valve, box, and fittings.

4.16. **Tapped Fire Hydrant**. "Tapped Fire Hydrant" will be measured as each fire hydrant including the various sizes of tapping sleeves, valves, and boxes installed.

4.17. **Relocate Fire Hydrant**. "Relocate Fire Hydrant" will be measured as each fire hydrant relocated.

4.18. **Permanent Blow-off (Complete)**. "Permanent Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

4.19. **Temporary Blow-off (Complete)**. "Temporary Blow-off (Complete)" will be measured as each assembly of the various sizes installed.

4.20. **Air Release Valve (Complete)**. "Air Release Valve (Complete)" will be measured as each assembly of the size installed.

4.21. **Trench Excavation Protection**. "Trench Excavation Protection" will be measured by the foot along the centerline of trench where the depth of trench exceeds 5 ft.

4.22. **Tie in (Complete)**. "Tie in (Complete)" will be measured as each of the various sizes and types completed.

4.23. **New Short Service**. “New Short Service” will be measured as each of the various sizes and types of new service lines installed.

4.24. **New Long Service**. “New Long Service” will be measured as each of the various sizes and types of new service lines installed.

4.25. **New Unmetered Short Service**. “New Unmetered Short Service” will be measured as each of the various sizes and types of new unmetered service lines installed.

4.26. **New Unmetered Long Service**. “New Unmetered Long Service” will be measured as each of the various sizes and types of new unmetered service lines installed.

4.27. **Reconnect Short Service**. “Reconnect Short Service” will be measured as each of the various sizes of service lines reconnected.

4.28. **Reconnect Long Service**. “Reconnect Long Service” will be measured as each of the various sizes of service lines reconnected.

4.29. **Relay Short Service**. “Relay Short Service” will be measured as each of the various sizes of service lines re-laid.

4.30. **Relay Long Service**. “Relay Long Service” will be measured as each of the various sizes of service lines re-laid.

4.31. **Relocate Short Service**. “Relocate Short Service” will be measured as each of the various sizes of service lines relocated.

4.32. **Relocate Long Service**. “Relocate Long Service” will be measured as each of the various sizes of service lines relocated.

4.33. **Relocate Existing Meter and Existing Meter Box**. “Relocate Existing Meter and Existing Meter Box” will be measured as each assembly relocated and customer's service reconnected.

4.34. **Relocate Existing Meter and New Meter Box**. “Relocate Existing Meter and New Meter Box” will be measured as each assembly relocated and customer's service reconnected.

4.35. **Cut and Replace Concrete Sidewalk, Driveway, Etc.** “Cut and Replace Concrete Sidewalk, Driveway, Etc.” will be measured by the square yard of surface area of the concrete sidewalk and driveway cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, “Width of Trench” or as shown on plans.

4.36. **Cut and Replace Concrete Sidewalk (Asphalt)**. “Cut and Replace Concrete Sidewalk (Asphalt)” will be measured by the square yard of surface area of concrete sidewalk to be cut and replaced with temporary asphalt (4 in. depth, Type C) pavement, but not to exceed the maximum trench width specified in Section 3.1.2, “Width of Trench” or as shown on the plans.

4.37. **Cut and Replace Asphalt Pavement**. “Cut and Replace Asphalt Pavement” will be measured by the square yard of surface area of the asphalt pavement cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, “Width of Trench” or as shown on plans.

4.38. **Cutting and Replacing Concrete Curb**. “Concrete Curb” will be measured by the foot of the concrete curb cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, “Width of Trench” or as shown on plans.

4.39. **Cut and Replace Asphalt Pavement with 6 in. Asphalt Treated Base**. "Cut and Replace Asphalt Pavement with 6 in. Asphalt Treated Base" will be measured by the square yard of surface area of the asphalt pavement cut and replaced with 6 in. of asphalt treated base, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.

4.40. **Hydrostatic Pressure Test**. "Hydrostatic Pressure Test" will be measured as each successful test conducted.

4.41. **Flowable Fill Backfill**. "Flowable Fill Backfill" will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill," but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on the plans.

4.42. **Water Service Line Breaks Leak Repair**. "Water Service Line Breaks Leak Repair" will be measured by the unit of each such assembly of all types and sizes of service lines, repair and tap clamps required to repair the service line break and or leak.

4.43. **Water Main Breaks Leak Repair**. "Water Main Breaks Leak Repair" will be measured by the unit of each such assembly of the various types and sizes of water mains, services, repair and tap clamps required to repair the water main break or leak.

4.44. **Ductile Iron and Gray Iron Fittings**. "Ductile Iron and Gray Iron Fittings" will be measured by the weight to the nearest 1/100 of a ton of the various sizes of fittings installed.

4.45. **Reinforced Concrete Vault**. "Reinforced Concrete Vault" will be measured by the each of the various sizes.

4.46. **Grout Abandonment Water Main**. "Grout Abandonment Water Main" will be measured by the unit foot of main grout abandoned of the various sizes to the limits shown on the plans.

4.47. **Removal Transport and Disposal of AC**. "Removal Transport and Disposal of AC" will be measured by the unit foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for Contractor's information only and the work will be performed by a third party contractor as per Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

4.48. **New Meter Box**. "New Meter Box" will be measured for payment as each new meter box is placed.

4.49. **Split Steel Casing**. "Split Steel Casing" will be measured by the foot, actually installed in the field, of the various sizes shown on the plans.

4.50. **Remove Existing Water Lines**. "Remove Existing Water Lines" will be measured by the foot of main removed of the various sizes at the locations as shown on the plans.

5. PAYMENT

The work performed and materials furnished in accordance with each item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work hereinafter described. These prices are to be full compensation for furnishing and hauling all materials; for placing or installing the materials; for inspection and testing; and for all other items of material, labor, equipment, tools, and incidentals necessary to complete the work in accordance with the plans and specifications.

5.1. **Pipe Water Main (DI), Pipe Water Main (PVC), Pipe Water Main (CSC), Pipe Water Main (PVC Casing) (Open Cut), and Pipe Water Main (Steel Casing) (Open Cut)**. Payment for "Pipe Water Main (DI)," "Pipe Water Main (PVC)," "Pipe Water Main (CSC)," "Pipe Water Main (PVC Casing) (Open Cut)," and "Pipe Water Main (Steel Casing) (Open Cut)" will be made at the unit price bid per foot of pipe of the various sizes installed by the open cut method. Documentation for passing all related testing, including backfill compaction,

must be provided to SAWS inspector prior to payment approval. This price will be full compensation for all labor, equipment, materials, tools, selected bedding, excavation, backfill materials, polyethylene sleeve, and hauling and disposition of surplus excavated materials.

5.2. **Fire Lines**. Payment for “Fire Lines” installed will be made at the unit price bid per linear foot of pipe of various sizes installed by the open cut method. This price will be full compensation for all labor, equipment, materials, tools, excavating selected embedment material, backfill, compaction of trench backfill, testing of compaction, tie in, polyethylene sleeve where required, hauling, disposing of surplus excavated material, and restoration of the surface, including asphalt, concrete, curbing, sidewalks, sod grass, landscaping, and any other surface type encountered. All replacement mains will include tie in costs for existing fire lines.

5.3. **Water (Jacking, Boring or Tunneling)**. Payment for “Water (Jacking, Boring or Tunneling),” will be paid for at the contract unit price bid per foot of jacking, boring or tunneling, which price will be full compensation for furnishing all materials (except carrier pipe, casings or liners), casing spacers, grout, labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, end caps, and disposal of surplus materials.

5.4. **Carrier Pipe Used in Bores or Tunnels**. Carrier pipe used in bores or tunnels will be paid for at the contract unit price bid for "Carrier Pipe (in Casing)" per foot which will be full compensation of pipe installed and measured as prescribed above.

5.5. **Carrier Pipe Installed in Open Cut Trenches**. Carrier pipe installed in open cut trenches will be paid for at the contract unit price bid for "Carrier Pipe for Open Cut Trench" per foot which will be full compensation of pipe installed and measured as prescribed above. Fifty percent of carrier pipe payment should be made after installation is completed. The remaining 50% should be paid after grouting and all applicable testing is approved.

5.6. **Casings or Liners Used in Bores or Tunnels**. Casings or liners used in bores or tunnels will be paid for at the contract unit price bid for "Casing (Bore)" per foot which will be full compensation of casing or liner installed and measured as prescribed above.

5.7. **Casings Installed in Open Cut Trenches**. Casings installed in open cut trenches will be paid for at the contract unit price bid for "Casing (Open Cut)" per foot which will be full compensation of casing installed and measured as prescribed above.

5.8. **Butterfly Valve and Box (Complete)**. Payment for “Butterfly Valve and Box (Complete),” will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required. Such payment is also to include mechanical or transition couplings, and coated and wrapped steel pipe nipples required to complete the connection.

5.9. **Gate Valve and Box (Complete)**. Payment for “Gate Valve and Box (Complete)” will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.

5.10. **Tapping Sleeve and Valve**. Payment for “Tapping Sleeve and Valve” will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous

surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.

5.11. **Cut in Tee (Complete)**. Payment for "Cut in Tee (Complete)" will be made at the unit price bid for each assembly of the various types and sizes of tees to be installed. This price will be full compensation for all labor, equipment, materials, tools, necessary tie ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, fittings, polyethylene sleeve when required, site restoration, and any necessary hauling and disposition of surplus excavated materials.

5.12. **Adjust Valve Box**. Payment for "Adjust Valve Box" will be made at the unit price bid which will be full compensation for each valve box adjusted to finish grade including all labor, materials, and incidentals to complete the work.

5.13. **Removal Transport and Disposal of AC**. Payment for "Removal Transport and Disposal of AC" will be made to a third party contractor through force account for safely removing, transporting, and disposing of AC pipe.

5.14. **Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars**. Payment will be made at the unit price bid for "Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" by the cubic yard of concrete placed, which price will be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment, and incidentals necessary to complete the work. Reinforcing, if required, will not be measured separately for payment.

5.15. **Fire Hydrant Assembly**. Payment for "Fire Hydrant Assembly" will be made at the unit prices bid which will be full compensation for each such assemblies, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified.

5.16. **Tapped Fire Hydrant**. Payment for "Tapped Fire Hydrant" will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified. Payment for "Fire Hydrant with Tapping Sleeve, 6 in. Valve and Box" will include tapping sleeve specified on plans and 6 in. valve and box.

5.17. **Relocate Fire Hydrant**. Payment for "Relocate Fire Hydrant" will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal and relocation of existing fire hydrant as specified.

5.18. **Permanent Blow-off (Complete)**. Payment for "Permanent Blow-off (Complete)" will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation, anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.

5.19. **Temporary Blow-off (Complete)**. Payment for "Temporary Blow-off (Complete)" will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details

shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation, anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.

5.20. **Air Release Valve (Complete)**. Payment for "Air Release Valve (Complete)" will be made at the unit price bid for each assembly of the various sizes installed in accordance with the details shown on the plans. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, excavation and hauling and disposition of surplus excavated materials, blocking, and various sizes and types of meter boxes.

5.21. **Trench Excavation Protection**. Payment for "Trench Excavation Protection" is to be made on the basis of the unit price bid which will be full compensation for each foot of "Trench Excavation Protection" in place. Payment is to include all components of the trench excavation safety protection system which can include, but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage. Payment is also to include the additional excavation and backfill required, any jacking, jack removal, and removal of the trench support after completion and be full compensation for all other labor, materials, tools, equipment, and incidentals necessary to complete the work.

5.22. **Tie in (Complete)**. Payment for "Tie in (Complete)" will be made at the unit price bid for each tie in of the various sizes and types completed. This price will be full compensation for all labor, equipment, materials, tools, shutdown, and isolation of the existing main to which the tie is to be made, cutting pipe for connection, de-watering the excavation, and customer notification of service interruption where required. Connections between new and existing mains which are made with tapping sleeves and valves by cutting in tees will be as a no separate pay item.

5.23. **New Short Service**. Payment for "New Short Service" will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger).

5.24. **New Long Service**. Payment for "New Long Service" will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger).

5.25. **New Unmetered Short Service**. Payment for "New Unmetered Short Service" will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

5.26. **New Unmetered Long Service**. Payment for "New Unmetered Long Service" will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with

whatever type specified, a new meter box where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

5.27. **Reconnect Short Service**. Payment for "Reconnect Short Service" will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.

5.28. **Reconnect Long Service**. Payment for "Reconnect Long Service" will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement, and surface structures of whatever type encountered and replacement with whatever type specified, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.

5.29. **Relay Short Service**. Payment for "Relay Short Service" will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.

5.30. **Relay Long Service**. Payment for "Relay Long Service" will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.

5.31. **Relocate Short Service**. Payment for "Relocate Short Service" will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.

5.32. **Relocate Long Service**. Payment for "Relocate Long Service" will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper, HDPE, PEXa tubing or ductile iron pipe (4 in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.

5.33. **Relocate Existing Meter and Existing Meter Box**. Payment for "Relocate Existing Meter and Existing Meter Box" will be made at the unit price bid for each assembly relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes, and types and in the quantities necessary to complete the connection between the relocated existing meter and the existing yard piping.

5.33.1. **Number One Meter Box Installation in Sidewalks and Driveways**. Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.

5.34. **Relocate Existing Meter and New Meter Box**. Payment for "Relocate Existing Meter and New Meter Box" will be made at the unit price bid for each assembly relocated. This price will be full compensation for all

labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the new meter box and the existing yard piping.

5.34.1. **Number One Meter Box Installation in Sidewalks and Driveways**. Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.

5.34.2. **Concrete Curbs, Driveways, Sidewalks, Islands and Medians**. Payment for replacement of curbs, driveways, sidewalks, islands and medians will be made at the unit price bid for "Concrete Sidewalk", "Concrete Driveway", "Concrete Islands", Concrete Medians", per square yard, and "Concrete Curb" per linear foot which will be full compensation for all labor, equipment, materials, tools and incidentals to complete the work. Payment for removal of curbs, driveways, sidewalks, islands, and medians will be made at the unit price bid for "Remove Concrete Sidewalk", "Remove Concrete Driveway", "Remove Concrete Islands", "Remove Concrete Medians" per square yard, and "Concrete Curb" per linear foot which will be full compensation for all labor, equipment, materials, tools and incidentals to complete the work.

5.35. **Cut and Replace Asphalt Pavement**. Payment for "Cut and Replace Asphalt Pavement" will be made at the unit price bid which will be full compensation of asphalt pavement removed and replaced.

5.36. **Cut and Restore Asphalt Pavement**. Payment for "Cut and Replace Asphalt Pavement" will be made at the unit price bid which will be full compensation of asphalt and asphalt treated base removed and placed at the thickness specified on plans.

5.37. **Hydrostatic Pressure Test**. Payment for "Hydrostatic Pressure Test" will be made at the unit price bid which will be full compensation for each successful test. Such payment includes all materials and equipment required to conduct test.

5.38. **Flowable Fill Backfill**. Payment for "Flowable Fill Backfill" will be made at the unit price bid, which will be full compensation for each cubic yard of flowable fill placed, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench."

5.39. **Water Service Line Breaks Leak Repair**. Payment for "Water Service Line Breaks Leak Repair" will be made for if during construction, certain water service lines break or if leaks occur within or immediately adjacent to the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed. However, the Contractor is cautioned that no payment will be made by SAWS when particular breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material, and pumping of water.

5.40. **Water Main Breaks Leak Repair**. Payment for "Water Main Breaks Leak Repair" will be made if during construction, certain water main breaks or if leaks occur within, or immediately adjacent to, the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed by the Contractor. The work involved must consist of excavation, hauling of disposition material, dewatering, shut-down and isolation of the existing main if required, installation of the necessary repair clamps and or new water main (length to be determined by the Inspector) to include all necessary tie ins, fittings, approved reaction blocking required, backfilling the excavation with approved materials; customer notification or service interruption where required. Cutting and replacing pavements (any type), curbs, sidewalks, trench protection, and sodding will be considered subsidiary to the work. However, the Contractor is cautioned that no payment will be made by SAWS when particular breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material, and pumping of water.

5.41. **Gray Iron Fittings and Ductile Iron Fittings**. Payment for "Gray Iron Fittings" and "Ductile Iron Fittings" will be made at the unit price bid for each ton of fittings of all sizes and types installed and will be based upon the weights of fittings shown in Table 20, "Weights of Ductile-Iron and Gray Cast-Iron Fittings." This price will be full compensation for all labor, equipment, materials, tools, excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets, and concrete reaction and thrust blocking. If compact fittings are not manufactured and other fittings are installed, Contractor will provide quantities and unit weights with pay request.

Weigh tables are estimated quantities and can be verified by vender information. Payments will be made by the lesser of the two (weights versus supplier) at the inspector's discretion.

5.42. **Reinforced Concrete Vault**. Payment for "Reinforced Concrete Vault" will be made at the unit price for each size vault installed.

5.43. **Grout Abandonment Water Main**. Payment for "Grout Abandonment Water Main" will be made for all types of pipe abandonment with grout, including asbestos-concrete pipe, and will be paid for at the contract bid price per foot for each size diameter of pipe, irrespective of the depth of the main, which will include the cost of removing content within the pipe, cleaning, grouting, plugging, capping and abandoning all pipe, pipe bend section and all other appurtenances, and for dewatering, trenching, excavation and backfill, removal, transportation and disposal and all material or work necessary to properly abandon the pipe. Payment for abandoning water lines will be made on the contract unit price per foot per each size diameter of pipe complete in place at locations shown on the plans. Said price will be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

5.44. **Removal Transport and Disposal of AC**. Payment for "Removal Transport and Disposal of AC" will be paid to a third party Contractor through force account for safely removing, transporting, and disposing of AC pipe.

5.45. **New Meter Box**. Payment for "New Meter Box" will be made at unit price bid which will be full compensation for all labor, equipment, materials, and tools required to set the new meter box.

No direct payment will be made for concrete blocking of water mains; coating and wrapping pipe joints; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; abandonment of water mains and valves; resetting existing meters and meter boxes in proper configuration; salvaging fire hydrants, valve boxes and meter boxes; flushing water mains; and disinfection of water mains. This work is to be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the nonmetallic pipe detection system. This work and materials are to be considered subsidiary to the various pay items. In addition, the Contractor is to ensure that the detection system is complete and operational to the satisfaction of the Engineer.

No direct payment will be made for furnishing and installing the pipe joint restraint system. This work and materials will be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the Joint Restraint System for PVC C-905. This work and materials will be considered subsidiary to the various pay items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.

5.46. **Split Steel Casing**. "Split Steel Casing" installed in open cut trenches will be paid for at the contract unit bid price per foot of pipe of the various sizes installed as shown on the plans. This price will be full compensation for all labor, equipment, materials, tools, selected bedding, excavation, backfill, backfill materials, spacers,

end seals, hauling and disposition of surplus excavated materials and all incidentals necessary to complete the work.

5.47. **Remove Existing Water Lines**. Payment for "Remove Existing Water Lines", 16 inches and smaller or larger than 16 inches, for all types of pipe removal, excluding Asbestos Cement (AC) pipe removal, and will be paid for at the contract unit bid price called out in the Measurement article, regardless of the depth of the main, which will include the cost of coordination, potholing, dewatering of pipe, groundwater dewatering, trench excavation, removing the utility, transporting and disposing of the utility, backfill and surface restoration, and all labor, equipment, tools and materials necessary to remove the pipe, pipe bends and all other appurtenances. Asbestos Cement (AC) pipe removal is to be performed and paid in accordance with Articles 3.2.21, 4.13, and 5.13.

Table 20
Weights of Gray Iron and Ductile Iron Fittings (lb.)

Bends							
Size (in.)	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**	**Size (in.)**	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**
1/4 Bend (90°)				**1/8 Bend (45°)**			
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580
Bends							
Size (in.)	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**	**Size (in.)**	**MJ Compact (C153)**	**MJ (C110)**	**FLG SB**
1/16 Bend (22-1/2°)				**1/32 Bend (11-1/4°)**			
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Tees				
Size (in.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53
4	3	31	76	54
	4	33	80	60
6	4	49	114	90
	6	60	124	98
8	4	65	163	155
	6	76	175	148
	8	89	188	179
12	4	99	316	322
	6	115	325	297
	8	127	339	346
	12	162	407	369
16	6	226	563	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	371	766	720
	12	427	799	816
	16	503	975	950
	20	566	1,068	1,005
24	6	466	1,035	1,089
	8	487	1,047	1,060
	12	539	1,075	1,125
	16	625	1,109	1,070
	20	729	1,504	1,510
	24	785	1,617	1,685
30	8	739	1,808	-
	12	800	1,842	1,801
	16	959	1,885	-
	20	1,026	1,941	-
	24	1,228	2,496	2,475
	30	1,373	2,531	2,615
36	24	1,548	2,710	2,255
	30	1,901	3,545	3,000
	36	2,012	3,686	3,160
42	24	2,272	3,690	3,245
	30	2,512	4,650	4,125
	36	3,048	5,119	5,360
	42	3,225	6,320	5,580
48	24	2,934	4,995	4,385
	30	3,147	5,140	4,455
	36	4,046	6,280	5,555
	42	4,249	8,130	7,195
	48	4,469	8,420	7,385

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Crosses				
Size (In.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	34	70	-
4	3	42	90	-
	4	46	105	-
6	4	63	140	-
	6	74	160	160
8	4	88	185	185
	6	97	205	205
	8	105	239	234
12	4	114	340	-
	6	135	360	360
	8	151	382	385
	12	199	493	495
16	6	250	590	575
	8	270	619	605
	12	332	685	-
	16	409	811	790
20	6	358	760	-
	8	379	822	790
	12	413	883	860
	16	550	1,117	1,085
	20	598	1,274	1,230
24	6	566	1,025	-
	8	578	1,085	1,045
	12	610	1,153	1,110
	16	663	1,256	1,200
	20	975	1,733	1,675
	24	907	1,906	1,835
30	8	650	1,795	-
	12	870	1,925	1,865
	16	900	1,950	-
	20	1,220	2,060	-
	24	1,497	2,776	2,675
	30	1,808	3,188	3,075
36	24	1,853	2,928	2,980
	30	2,580	3,965	-
	36	2,698	4,370	4,370
42	24	2,415	3,910	-
	30	2,920	5,040	-
	36	3,788	5,835	-
	42	3,908	6,493	7,145
48	24	3,435	5,210	-
	30	4,145	5,495	-
	36	4,873	6,790	-
	42	5,465	8,815	-
	48	5,588	9,380	-

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Caps			Plugs	
Size (In.)	MJ Compact (C153)	MJ (C110)	MJ Compact (C153)	MJ (C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Solid Sleeves				
Size (In.)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1,005
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Concentric Reducers			
Size (In.)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1042	1,459
36	24	785	1,580
36	30	655	1,868

Concentric Reducers			
Size (In.)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

2" Tapped Tees and Crosses		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4	24	47
6	36	71
8	54	97
10	69	130
12	87	169
20	-	259
24	-	320

Table 20 Continuation
Weights Of Gray Iron and Ductile Iron Fittings (lb.)

Offsets		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4 x 6	35	75
4 x 12	55	83
6 x 6	35	110
6 x 12	67	138
6 x 24	96	189
8 x 6	82	164
8 x 12	98	209
8 x 24	141	280
12 x 6	121	320
12 x 12	178	420
12 x 24	240	645
20 x 12	-	1,025
20 x 24	-	1,245

BID SCHEDULE OF VALUES
(BASE BID)

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
162	7002	4136	SY	Block Sodding complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
162	7004	28906	SY	Mulch Sodding complete in place, the sum of _____ _____Dollars and _____Cents per Square yard		
168	7001	3	TGL	Vegetative Watering complete in place, the sum of _____ _____Dollars and _____Cents per Thousand Gallon		
169	7001	6278	SY	Soil Retention Blankets (SL_MOD_CLAY_SHORT) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
170	7001	1	LS	Irrigation System complete in place, the sum of _____ _____Dollars and _____Cents per Lump Sum		
193	7001	1	MO	Landscape Establishment complete in place, the sum of _____ _____Dollars and _____Cents per Month		
216	7001	25	HR	Proof Rolling complete in place, the sum of _____ _____Dollars and _____Cents per Hour		
260	7005	39	TON	Lime (Commercial or Quicklime) (Slurry) Or Quicklime (Dry) complete in place, the sum of _____ _____Dollars and _____Cents per Ton		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
260	7020	63743	SY	Lime Treated (Subgrade) (8 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
341	7003	7	TON	Dense Graded HMAC Type B With PG64-22 Binder complete in place, the sum of _____ _____Dollars and _____Cents per Ton		
341	7015	637	TON	Dense Graded HMAC Type C With PG64-22 Binder complete in place, the sum of _____ _____Dollars and _____Cents per Ton		
341	7064	18	TON	Dense Graded HMAC Type D With PG64-22 Binder v complete in place, the sum of _____ _____Dollars and _____Cents per Ton		
354	7033	143	SY	Plane Asphalt Concrete Pavement (0"-3") complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
360	7004	57261	SY	Concrete Pavement (Continuously Reinforced) (10 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
401	7001	120	CY	Flowable Backfill complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
402	7001	8732	LF	Trench Excavation Protection complete in place, the sum of _____ _____Dollars and _____Cents per Square Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
403	7001	4064	SF	Temporary Special Shoring complete in place, the sum of _____ _____Dollars and _____Cents per Square Foot		
432	7001	767	CY	Riprap (Concrete) (4 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
432	7012	60	CY	Riprap (Concrete) (Flume) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
432	7013	79	CY	Riprap (Mow Strip) (4 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
432	7031	141	CY	Riprap (Stone Common) (Dry) (12 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
432	7032	140	CY	Riprap (Stone Common)(Dry) (15 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
432	7038	939	CY	Riprap (Stone Common)(Grout) (12 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Cubic Yard		
462	7003	592	LF	Concrete Box Culvert (4 ft x 2 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
462	7003	52	LF	Concrete Box Culvert (4 ft x 3 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
462	7006	553	LF	Concrete Box Culvert (5 ft x 2 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
462	7010	168	LF	Concrete Box Culvert (6 ft x 2 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
462	7033	540	LF	Concrete Box Culvert (10 ft x 5 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7001	12	LF	Reinforced Concrete Pipe (Class III) (12 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7003	94	LF	Reinforced Concrete Pipe (Class III) (18 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7005	129	LF	Reinforced Concrete Pipe (Class III) (24 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
464	7009	665	LF	Reinforced Concrete Pipe (Class III) (36 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7011	2772	LF	Reinforced Concrete Pipe (Class III) (48 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7019	176	LF	Reinforced Concrete Pipe (Class IV) (18 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
464	7021	727	LF	Reinforced Concrete Pipe (Class IV) (24 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
465	7002	8	EA	Manhole (Complete) (PRM) (48 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
466	7159	2	EA	Wingwall (FW- S) (HW = 3 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
466	7189	2	EA	Headwall (PW - 2) (HW = 5 ft) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7066	16	EA	Safety End Treatment (Type I) (S = 4 ft) (HW = 2 ft) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
467	7070	2	EA	Safety End Treatment (Type I) (S = 4 ft) (HW = 3 ft) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7094	6	EA	Safety End Treatment (Type I) (S = 5 ft) (HW = 2 ft) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7123	10	EA	Safety End Treatment (Type I) (S = 6 ft) (HW = 2 ft) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7308	8	EA	Safety End Treatment (Type II) (18 inch) (Reinforced Concrete Pipe) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7328	30	EA	Safety End Treatment (Type II) (24 inch) (Reinforced Concrete Pipe) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
467	7368	15	EA	Safety End Treatment (Type II) (36 inch) (RCP) (6:1) (P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
479	7001	2	EA	Adjusting Manholes complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
500	7001	1	LS	Mobilization complete in place, the sum of _____ _____Dollars and _____Cents per Lump Sum		
502	7001	30	MO	Barricades, Signs and Traffic Handling complete in place, the sum of _____ _____Dollars and _____Cents per Month		
503	7002	2	EA	Portable Changeable Message Sign complete in place, the sum of _____ _____Dollars and _____Cents per Month		
506	7002	1350	LF	Rock Filter Dams (Install) (Type II) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
506	7003	455	LF	Rock Filter Dams (Install) (Type III) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
506	7011	1805	LF	Rock Filter Dams (Remove) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
506	7020	778	SY	Construction Exits (Install) (Type 1) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
506	7024	778	SY	Construction Exits (Remove) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
506	7042	126	LF	Biodegradable Erosion Control Logs (Install) (6-Inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
506	7039	5787	LF	Temporary Sediment Control Fence (Install) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
506	7041	5787	LF	Temporary Sediment Control Fence (Remove) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
512	7005	200	LF	Portable Concrete Traffic Barrier (Furnish & Install) (F-Shape) (Type 1) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
512	7029	200	LF	Portable Concrete Traffic Barrier (Move) (F-Shape) (Type 1) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
512	7053	200	LF	Portable Concrete Traffic Barrier (Remove) (F-Shape) (Type 1) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
527	7002	906	SY	Colored Textured Concrete (5 Inch) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
527	7007	815	SY	Colored Textured Concrete (10 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
529	7007	961	LF	Concrete Curb (Mono) (Type II) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
530	7006	4251	SY	Driveways (Concrete) complete in place, the sum of _____ _____Dollars and _____Cents per Square Yard		
540	7002	1524	LF	Metal W-Beam Guard Fence (Steel Post) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
540	7015	4	EA	Downstream Anchor Terminal Section complete in place, the sum of _____ _____Dollars and _____Cents per Each		
540	7027	150	LF	Metal Beam Guard Fence (Long Span System) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
544	7001	4	EA	Guardrail End Treatment (Install) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
545	7002	1	EA	Crash Cushion Attenuator (Move and Reset) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
545	7004	1	EA	Crash Cushion Attenuator (Remove) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
545	7010	1	EA	Crash Cushion Attenuator (Install)(R)(N)(TL3) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
550	7017	11	EA	Remove and Install Existing Gate complete in place, the sum of _____ _____Dollars and _____Cents per Each		
552	7001	472	LF	Install Fence (WF) (Type A) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
552	7002	829	LF	Install Fence (WF) (Type B) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
552	7003	826	LF	Install Fence (WF) (Type C) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
552	7004	1291	LF	Install Fence (WF) (Type D) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
552	7005	830	LF	Wire Fence (Special) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
552	7011	5277	LF	Wire Fence (Remove) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
552	7016	1685	LF	Install Fence (Pipe Rail) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
552	7017	1114	LF	Install Fence (Vinyl Rail) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
560	7000	12	EA	Temporary Mailbox complete in place, the sum of _____ _____Dollars and _____Cents per Each		
560	7012	12	EA	Relocate Existing Mailbox complete in place, the sum of _____ _____Dollars and _____Cents per Each		
610	7005	2	EA	Relocate Roadside Illumination Assembly complete in place, the sum of _____ _____Dollars and _____Cents per Each		
618	7015	142	LF	Conduit (HDPE) (4 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
618	7040	649	LF	Conduit (PVC)(Schedule 40)(4 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
644	7057	12	EA	Install Small Road Sign Support & Assembly Type TWT (1) WS(P) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
644	7058	1	EA	Install Small Road Sign Support & Assembly Type TWT (1) WS(T) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
644	7068	13	EA	Relocate Small Road Sign Support & Assembly (Type TWT) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
644	7111	1	EA	Remove and Relocate Sign "A Painting Place" complete in place, the sum of _____ _____Dollars and _____Cents per Each		
644	7112	1	EA	Remove and Relocate Sign "Trinity Tabernacle" _____ _____Dollars and _____Cents per Each		
644	7113	1	EA	Remove and Relocate Sign "Cornerstone Church" complete in place, the sum of _____ _____Dollars and _____Cents per Each		
644	7114	2	EA	Remove and relocate Sign "Student Drop-Off/Pick-up/ Staff/Faculty Parking" complete in place, the sum of _____ _____Dollars and _____Cents per Each		
658	7011	46	EA	Install Delineator Assembly (D-SW) SZ-2 (WC) GND (BR) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
658	7017	26	EA	Install Delineator Assembly (D-SW) SZ-1 (BRF) GF1 (BR) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
658	7072	4	EA	Install Object Marker Assembly (OM-4) (TWT) (WAS) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
662	7051	257	EA	Work Zone Pavement Markings Remov (Reflectors) Type II-A-A complete in place, the sum of _____Dollars and _____Cents per Each		
662	7064	5287	LF	Work Zone Pavement Markings Remov (White) 4 inch (Solid) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
662	7095	606	LF	Work Zone Pavement Markings Remov (Yellow)4 inch (Broken) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
662	7097	3298	LF	Work Zone Pavement Markings Remov (Yellow)4 inch (Solid) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7008	334	LF	Reflective Pavement Markings Type I (White) 6 inch (Dot)(90 mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7023	3344	LF	Reflective Pavement Markings Type I (White) 8 inch (Solid)(90 mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
666	7029	300	LF	Reflective Pavement Markings Type I (White) 12 inch (SLD) (90 mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7035	112	LF	Reflective Pavement Markings Type I (White) 24 inch (SLD) (90 mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7041	37	EA	Reflective Pavement Markings Type I (White) Arrow (90 MIL) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7065	21	EA	Reflective Pavement Markings Type I (White) (Word) (90 mil) complete in place, the sum of _____Dollars and _____Cents per Each		
666	7131	29	LF	Reflective Pavement Markings Type I (Yellow) (Median Nose) (90 mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7168	1887	LF	Reflective Pavement Markings Type II White) (4 inch) (Broken) (90 mil) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7171	15641	LF	Reflective Pavement Markings Type II (White) 4 inch (Solid) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
666	7184	20	LF	Reflective Pavement Markings Type II (White) 24 inch (Solid) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7208	7782	LF	Reflective Pavement Markings Type II (Yellow) 4 inch (Broken) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7210	1819	LF	Reflective Pavement Markings Type II (Yellow) 4 inch (Solid) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7220	30	EA	Reflective Pavement Markings Type II (Yellow) (Median Nose) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7347	33381	LF	Pavement Sealer (6 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7348	3344	LF	Pavement Sealer (8 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7350	300	LF	Pavement Sealer (12 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7352	112	LF	Pavement Sealer (24 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
666	7353	37	EA	Pavement Sealer (Arrow) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7354	21	EA	Pavement Sealer (Word) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
666	7355	30	EA	Pavement Sealer (Median Nose) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
666	7407	15081	LF	Refelctive Pavement Markings Type 1 (White) 6 inch (Broken) (90 Mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7410	15462	LF	Refelctive Pavement Markings Type 1 (White) 6 inch (Solid) (90 Mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
666	7422	2504	LF	Refelctive Pavement Markings Type 1 (Yellow) 6 inch (Dot) (90 Mil) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
672	7002	357	EA	Reflective Pavement Markers Type 1-C complete in place, the sum of _____ _____Dollars and _____Cents per Each		
672	6009	124	EA	Reflective Pavement Markers Type II-A-A complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
672	6010	754	EA	Reflective Pavement Markers Type II-C-R complete in place, the sum of _____ _____Dollars and _____Cents per Each		
672	7022	20	EA	Reflective Pavement Markers Type II-B-B complete in place, the sum of _____ _____Dollars and _____Cents per Each		
677	7001	250	LF	Eliminate Existing Pavement Markers & Markings (4 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
678	7002	33381	LF	Pavement Surface Preparation for Markings (6 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
678	7004	3344	LF	Pavement Surface Preparation for Markings (8 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
678	7008	112	LF	Pavement Surface Preparation for Markings (24 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
678	7009	37	EA	Pavement Surface Preparation for Markings (Arrow) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
678	7016	21	EA	Pavement Surface Preparation for Markings (Word) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
678	7024	30	EA	Pavement Surface Preparation for Markings (Median Nose) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
678	7033	501	EA	Pavement Surface Preparation for Markings (Raised Pavement Markers) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
685	7005	3	EA	Relocate Roadside Flashing Beacon Assembly (Solar Powered) complete in place, the sum of _____Dollars and _____Cents per Each		
1002	7013	1	LS	Remove and Relocate Existing Landscape Features complete in place, the sum of _____Dollars and _____Cents per Lump Sum		
1002	7029	50	EA	Remove and Reset Rock/Boulder complete in place, the sum of _____ _____Dollars and _____Cents per Each		
1004	1004	1	EA	Tree Protection complete in place, the sum of _____ _____Dollars and _____Cents per Each		
5044	7001	2	EA	Headwall (Stone Masonry) complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
7014	7001	15	LF	Curb Inlet Sediment Protection complete in place, the sum of _____ _____Dollars and _____Cents per Linear Foot		
7004	7025	18	EA	Cut and Plug Water Main (6 inch) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
7004	7032	18	EA	Gate Valve (6 Inch) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
7004	7055	8	EA	Remove and Relocate Meters and Boxes complete in place, the sum of _____ _____Dollars and _____Cents per Each		
7004	7063	1	LS	Utility Adjustments complete in place, the sum of _____ _____Dollars and _____Cents per Lump Sum		
7019	7001	5	EA	Subsurface Utility Locate (Outside Roadbed) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
7019	7002	2	EA	Subsurface Utility Locate (Inside Roadbed) complete in place, the sum of _____ _____Dollars and _____Cents per Each		
7033	7001	17	EA	Adjusting Water Valve Box To Grade complete in place, the sum of _____ _____Dollars and _____Cents per Each		

Item No.		Estimated Quantity	Unit	Description and Price in Words	Unit Price in Figures	Item Subtotal
7049	7064	4	EA	Adjust Existing Water Meter complete in place, the sum of _____Dollars and _____Cents per Each		
7049	7102	2	EA	Adjust Hydrant complete in place, the sum of _____Dollars and _____Cents per Each		
7049	7103	8	EA	Relocate Existing Water Meter And Relay Existing Service complete in place, the sum of _____Dollars and _____Cents per Each		
7049	7015	18	EA	Remove and Replace Fire Hydrant complete in place, the sum of _____Dollars and _____Cents per Each		
7006	7001	5850	LF	Abandon/Fill Existing Sanitary Sewer Pipe (8 Inch) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
7006	7076	440	LF	Jack, Bore or Tunnel Sanitary Sewer Force Main (HDPE) (DR 13.5) (18 Inch) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
7006	7077	5417	LF	Sanitary Sewer Force Main (HDPE) (DR 13.5) (8 Inch) complete in place, the sum of _____Dollars and _____Cents per Linear Foot		
7040	7033	2	EA	Air Release Valve (Complete) (2 Inch) complete in place, the sum of _____Dollars and _____Cents per Each		
					TOTAL BID AMOUNT:	

FORMS DUE BY BID SUBMITTAL

BID ENDORSEMENT

The Contractor hereby agrees to commence work within Ten (10) days after the date written notice to do so shall have been given to him, and to substantially complete the same within _____ calendar days after the date of the written notice to commence work subject to such extensions of time as are provided by the General and Special Conditions. The work proposed to be done shall be accepted when fully completed and finished in accordance with the plans and specifications.

In the event of the award of a contract to the undersigned, the undersigned will furnish a Performance Bond and Payment Bond for the full amount of the contract.

The undersigned certifies that the bid prices contained in this proposal have been carefully checked and are submitted as correct and final.

NOTE: Unit and lump sum prices must be shown in words and figures for each item listed in the proposal and in the event of discrepancy the words shall control.

Receipt is hereby acknowledged for the following addenda to the contract documents:

Addendum No. 1 dated	_____	Received	_____
Addendum No. 2 dated	_____	Received	_____
	_____		_____

The undersigned, in submitting this bid proposal and their endorsement of same, represents that they are authorized to obligate their firm, that they have read this entire bid proposal package, is aware of the covenants contained herein and will abide by and adhere to the expressed requirements. Submittals will be considered as being responsive only if entire Bid Package plus any/all attachments is returned with all blanks completed.

A. Total Amount Bid:	**$**
B. Total Calendar Days Bid:	**Days**

_____
Contractor

By: _____
(please print name)

Signature: _____

Title: _____

Seal and Authorization
(If a Corporation)

_____
Address

_____
City, County, State and Zip

_____
Telephone Fax No.

E-Mail Address: _____

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	☐ COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	☐ CLAIMS-MADE ☐ OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$
	☐ POLICY ☐ PRO-JECT ☐ LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	☐ ANY AUTO						BODILY INJURY (Per person)	$
	☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	☐ HIRED AUTOS ☐ NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	☐ **UMBRELLA LIAB** ☐ OCCUR						EACH OCCURRENCE	$
	☐ **EXCESS LIAB** ☐ CLAIMS-MADE						AGGREGATE	$
	☐ DED ☐ RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N						☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ **(Mandatory in NH)**	N / A					E.L. EACH ACCIDENT	$
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$
							E.L. DISEASE - POLICY LIMIT	$

S A M P L E

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER	CANCELLATION
	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

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AFFIDAVIT OF NO PROHIBITED INTEREST

I, the undersigned, declare and affirm that no person or officer in this sole proprietorship, partnership, corporation, or board has or will have during the term of this contract a prohibited interest as that is defined in City Charter Section 10.05.

I further understand and acknowledge that the existence of a prohibited interest at any time during the term of this contract will render the contract voidable.

_____
Name of Contractor

By:_____
Signature

_____
(Print Name)

_____
(Title)

STATE OF TEXAS §

COUNTY OF _____ §

SUBSCRIBED AND SWORN TO before me this _____ day of _____, 2022.

_____
Notary Public, State of Texas

BIDDERS QUALIFICATION STATEMENT

Project: Bid No. _____

Contractor: _____

Indicate One: _____ Sole Proprietor _____ Partnership _____ Other

_____ Corporation _____ Joint Venture

Name: _____ Partner: _____

Title: _____ Title: _____

Address: _____ Address: _____

City: _____ City: _____

State & Zip: _____ State & Zip: _____

Phone: _____ Phone: _____

State and Date of Incorporation, Partnership, Ownership, Etc. _____

Location of Principal Office: _____

Contact and Phone at Principal Office: _____

Liability Insurance Provider and Limits of Coverage: _____

Workers compensation Insurance Provider: _____

Address: _____

Contact and Phone: _____

Number of Years in Business as a Contractor on Above Types of Work: _____

Claims and Suits (If the answer to any of the questions is yes, please attach details):

Has your organization ever failed to complete any work awarded to it?

Are there any judgments, claims, arbitration proceedings, or suits pending or outstanding against your organization or its officers?

Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five years?

Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract?

List your most current agreements/contracts, with information, similar to the type of work bid.
(Use Additional Sheets if Necessary)

Project: _____

Project Description: _____

Owner/Agency: _____

Contract Price: _____

Contact Person: _____ Phone: _____Email_____

Project: _____

Project Description: _____

Owner/Agency: _____

Contract Price: _____

Contact Person: _____ Phone: _____Email_____

Project: _____

Project Description: _____

Owner/Agency: _____

Contract Price: _____

Contact Person: _____ Phone: _____Email_____

Bank References (List Institution, Address, Contact Person, and Phone):

_____

_____

_____

SUPPLEMENTAL INFORMATION

Please provide the following information for contract development:

Is the company a	1.	Sole Proprietorship	_____ Yes	_____ No
	2.	General Partnership	_____ Yes	_____ No
	3.	Limited Partnership	_____ Yes	_____ No
	4.	Corporation	_____ Yes	_____ No
	5.	Other	_____ Yes	_____ No

If the company is a **sole proprietorship**, please list the owner's full legal name, the name under which business is conducted (i.e. d/b/a), the address for the company, including the state and county in which your business is located:

_____

_____

If the company is a **general partnership**, please list the exact name of the partnership, whether it is a partnership formed under the laws of the State of Texas or another state, the business address for the partnership, including the state and county, and list of the names of all of the partners for the partnership:

_____

_____

If the company is a **limited partnership**, please list the exact name of the limited partnership, whether it is a limited partnership formed under the laws of the State of Texas or another state, the business address for the limited partnership, including the state and county, and list the names of all the general partners for the partnership:

_____

_____

If the company is a **corporation**, please list the exact name of the corporation, whether it is a corporation formed under the laws of the State of Texas or another state, the business address for the corporation, including the state and county, and list the names of all of the officers for the corporation:

_____

_____

If the company is **another entity** not listed above, please list the exact name and type of company, the state under which it is formed, the business address for the company, including the state and county, and list the names of all of the persons authorized to act on the company's behalf:

_____

_____

Is the company a minority, or woman owned business enterprise?

_____No _____ Yes if yes, specify: _____ MBE _____ WBE

Has the company been certified as a minority/woman owned business by any governmental agency?

_____ No _____ Yes

If yes, specify the governmental agency: _____

Date of certification: _____

CONFLICT OF INTEREST QUESTIONNAIRE FORM CIQ

For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.
This questionnaire is being filed in accordance with Chapter 176, Local Government Code by a person who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the person meets requirements under Section 176.006(a). By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. *See* Section 176.006, Local Government Code. A person commits an offense if the person knowingly violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

OFFICE USE ONLY

Date Received

1. **Name of person who has a business relationship with local governmental entity.**

2. **Are filing an update to a previously filed questionnaire. YES_____ NO_____**

   (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3. **Name of local government officer with whom filer has employment or business relationship.**

   _____
   Name of Officer

   This section (item 3 including subparts A, B, C & D) must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.

   A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire? Yes _____ No_____

   B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not received from the local governmental entity? Yes_____ No_____

   C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?

   Yes_____ No_____

   D. Describe each employment or business relationship with the local government officer named in this section.

4. _____
   Signature of person doing business with the governmental entity Date

SCHEDULE OF SUBCONTRACTORS

Bidder/Contractor: _____ _____ Small _____ WBE _____ MBE

_____ Non-S/M/WBE

Description: _____ Contract/Solicitation Number: ____

Check the applicable: _____ Subcontracting/Vendor Opportunities _____ Sole Source _____ Direct Purchase

NOTE: If contract is a sole source and/or direct purchase, please enter the dollar amount of work to be completed and proceed to the Contractor's Certification, then sign and date this form.

As part of the procedures for the submission of Proposals, all Bidders/Contractors are required to identify ALL participating subcontractors/suppliers. Please identify such areas for above project, if applicable. Use additional sheets if necessary.

	BUSINESS STATUS					
Name of company performing work	**SM.**	**MBE**	**WBE**	**Non S/M/WBE**	**Description of Commodity, Material, or Service**	**Dollar Amount**
						$
						$
						$
						$
						$
						$
Dollar Amount of Work to be completed by Non-S/M/WBE Subcontractors						$
Dollar Amount of Work to be completed by S/M/WBE Subcontractors						$
Total (the total amount shall equal the amount proposed on summary of proposal page)						$

CONTRACTOR'S CERTIFICATION

The above information is true and complete to the best of my knowledge and belief. I further understand and agree that if awarded the Contract, the certification shall be attached thereto and become a part thereof. Failure to provide accurate information or exercise positive, good faith efforts (as defined by the City's Business Diversity Program) in support of the City's small/minority/women business program good faith efforts.

Name and Title of Signer: _____

Signature: _____ Date: _____

WORK FORCE COMPOSITION

Name of Firm Area Code/Phone Number

Address City State Zip

Typed Name & Title of Authorized Executive

Full Time Employees	Total Number of Employees			White			American Indian			Black			Hispanic			Other		
	M	F	%	M	F	%	M	F	%	M	F	%	M	F	%	M	F	%
Admin & Managerial																		
Professional																		
Technical																		
Sales Workers																		
Office & Clerical																		
Skilled Workers																		
Semiskilled Workers																		
Unskilled Workers																		
Apprentices																		
Seasonal, Temp & Part Time																		
TOTAL																		

WORK FORCE COMPOSITION

Remarks _____

CONTRACTOR'S CERTIFICATION

The above information is true and complete to the best of my knowledge and belief. I further understand and agree that if awarded the contract, this certification shall be attached thereto and become a part thereof.

Name and Title of Signer: _____
(Please print or type)

Signature: _____ Date: _____

(*Please use additional sheets to identify the ethnicity of employees identified in this category.)

FORMS DUE AFTER AWARD

&

PRIOR TO CONTRACT EXECUTION

PROPOSAL
TO
CITY OF LUCAS (OWNER)

WEST LUCAS ROAD RECONSTRUCTION AND WIDENING

LUCAS, COLLIN COUNTY, TEXAS

The undersigned, as bidder, declares that the only person or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm, or corporation, that he has carefully examined the Form of Contract, Notice to Contractors, specifications and the plans therein referred to, and has carefully examined the location, conditions, and classes of materials of the proposed work, and agrees that he will provide all the necessary labor, machinery, tools, apparatus, and other items incidental to construction, and will do all the work and furnish all the materials called for in the contract and specifications in the manner prescribed therein.

It is understood that the following quantities of work to be done at unit prices are approximate only, and are intended principally to serve as a guide in evaluating bids.

It is further agreed that the quantities of work to be done at unit prices and material to be furnished may be increased or diminished as may be necessary to complete the work fully as planned and contemplated, and that all quantities of work, whether increased or decreased, are to be performed at the unit prices set forth below except as provided for in the specifications.

It is agreed further that lump sum prices may be increased to cover additional work not shown on the plans or required by the specifications, in accordance with the provisions of the General Conditions. Similarly, the price may be decreased to cover deletions of work so ordered.

It is understood and agreed that the work is to be completed in full within the time designated in the Special Conditions of these specifications.

Accompanying this proposal is a (Certified or Cashier's Check payable to the Owner) (Bid Bond) in the amount of _____ Dollars ($ _____).

The bid security accompanying this proposal shall be returned to the bidder, unless in case of the acceptance of the proposal the bidder shall fail to execute a contract and file a performance and payment bond within ten (10) days after its acceptance, in which case the bid security shall become the property of the Owner and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner on account of such failure of the bidder. It is understood that the Owner reserves the right to reject any and all bids

STANDARD FORM OF AGREEMENT

STATE OF TEXAS }

COUNTY OF COLLIN }

THIS AGREEMENT, made and entered into this _____ day of _____, 2022, by and between The City of Lucas, Texas, a municipal corporation, of the County of Collin and State of Texas, acting through Its City Manager _____ thereunto duly authorized so to do, Party of the First Part, hereinafter termed OWNER, and _____ of the City of _____, County of _____ and State of Texas, Party of the Second Part, hereinafter termed CONTRACTOR.

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the Party of the First Part (OWNER), and under the conditions expressed in the bond bearing even date herewith, the said Party of the Second Part (CONTRACTOR), hereby agrees with the said Party of the First Part (OWNER) to commence and complete the construction of certain improvements described as follows:

West Lucas Road Reconstruction and Widening
Bid No. XXX-XX

and all extra work in connection therewith, under the terms as stated in the General Conditions of the Agreement and at his (or their) own proper cost and expense to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said construction, in accordance with the conditions and prices stated in the Proposal attached hereto, and in accordance with the Notice to Contractors, General and Special Conditions of Agreement, Plans and other drawings and printed or written explanatory matter thereof, and the Specifications and addenda together with the CONTRACTOR'S written Proposal, the General Conditions of the Agreement, and the Performance and Payment Bonds hereto attached; all of which are made a part hereof and collectively evidence and constitute the entire contract.

The CONTRACTOR hereby agrees to commence work within ten (10) days after the date written notice to do so shall have been given to him, and to substantially complete the same within _____ (_____) **calendar days** after the date of the written notice to commence work, subject to such extensions of time as are provided by the General and Special Conditions.

THE OWNER agrees to pay the CONTRACTOR in current funds the price or prices shown in the proposal, which forms a part of this contract, such payments to be subject to the General and Special Conditions of the contract.

IN WITNESS WHEREOF, the parties to these presents have executed this Agreement in the year and day first above written.

CITY OF LUCAS, TEXAS	_____
Party of the First Part (OWNER)	Party of the Second Part (CONTRACTOR)
By: _____	**By:** _____
Joni Clarke, City Manager	
Attest: _____	**Attest:** _____
Stacy Henderson, City Secretary	

BID BOND

THE STATE OF TEXAS §

SURETY'S NO._____

COUNTY OF_____ §

KNOW ALL MEN BY THESE PRESENTS, THAT_____

_____

_____

(hereinafter called the Principal), as Principal, and _____

_____

(hereinafter called the Surety), as Surety, are bound unto the City of **Lucas**, Texas, a home rule municipal corporation of **Collin** County, Texas (hereinafter called Obligee) in the amount _____DOLLARS ($_____),

for the payment whereof said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid to enter into a certain written Contract with

_____

_____

_____

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully, enter into such written Contract, then this obligation shall be void; otherwise to remain in full force and effect.

IT IS EXPRESSLY UNDERSTOOD AND AGREED that if said Principal should withdraw its Bid anytime after such Bid is opened and before official rejection of such Bid or, if successful in securing the award thereof, said Principal should fail to enter into the Contract and furnish satisfactory Performance Bond and Payment Bond, the Obligee, in either of such events, shall be entitled and is hereby given the right to collect the full amount of this Bid Bond as liquidated damages.

PROVIDED, further that if any legal action be filed upon this Bond, venue shall lie in **Collin** County, Texas.

IN WITNESS WHEREOF, the said Principal and Surety do sign and seal this instrument, this

_____ day of _____, 20_____.

_____	_____
Principal/Contractor	Surety
By_____	By_____
Address_____	Address_____
_____	_____

NOTE: Attach Power of Attorney

SAMPLE EXHIBITS

CITY OF LUCAS, TEXAS

PUBLIC WORKS CONSTRUCTION PROJECT

West Lucas Road

Widening, Bid

#045-26

Vendor name

TABLE OF CONTENTS

ARTICLE I; THE CONTRACT AND THE CONTRACT DOCUMENTS 1
1.1 The Contract 1
1.2. The Contract Documents 1
1.3 Entire Agreement 1
1.4 No Privity with Others 1
1.5 Intent and Interpretation 1
1.6 Ownership of Contract Documents 2

ARTICLE II; THE WORK 2
2.1 2
2.2 Work 2

ARTICLE III; CONTRACT TIME 3
3.1 Substantial Completion 3
3.2 Time 3
3.3 Time is of the Essence 3
3.4 Liquidated Damages; Early Completion Bonus 4
3.5 No Damages for Delay; No Back-Charges; Damage Waiver 4

ARTICLE IV; CONTRACT PRICE 5
4.1 The Contract Price 5

ARTICLE V; PAYMENT OF THE CONTRACT PRICE 5
5.1 Schedule of Values 5
5.2 Payment Procedure 5
5.3 Withheld Payment 6
5.4 Unexcused Failure to Pay 6
5.5 Certificate of Substantial Completion 7
5.6 Completion and Final Payment 7

ARTICLE VI; THE CITY 8
6.1 Information, Services and Things Required from City 8
6.2 Right to Stop Work 8
6.3 City's Right to Perform Work 8

ARTICLE VII; THE CONTRACTOR 8
7.1 Must Follow Contract 8
7.2 Use of Web-Based Project Management System 8
7.3 Prosecution of Work 8
7.4 Warranty 9
7.5 Permits; Fees; Licenses 9
7.6 Supervision 9
7.7 Work Schedule 9
7.8 On-Site Drawings 10
7.9 As-Built Plans, Shop Drawings, Product Data, and Samples 10
7.10 Cleaning the Site and the Project 10
7.11 Access to Work and Inspections 10
7.12 Indemnity and Disclaimer 10
7.13 Nondiscrimination 11
7.14 Prevailing Wage Rates 11
7.15 Job Site Safety Precautions 11
7.16 Warning Devices and Barricades 12
7.17 Protection of Utilities and Other Contractors 12

ARTICLE VIII; CONTRACT ADMINISTRATION 12
8.1 The Engineer 12
8.2 Engineer's Administration 12
8.3 Claims by the Contractor 13
8.4 Extra Work 13
8.5 Claims for Additional Costs or Time; Contract Price Increase 14
8.6 Field Orders 14
8.7 Mediation 14

ARTICLE IX; SUBCONTRACTORS 15
9.1 Definition 15
9.2 Award of Subcontracts 15

ARTICLE X; CHANGES IN THE WORK 15
10.1 Changes Permitted 15
10.2 Change Order Defined 15
10.3 Changes in the Contract Price 15
10.4 Minor Changes 16
10.5 Effect of Executed Change Order 16
10.6 Notice to Surety; Consent 16

ARTICLE XI; UNCOVERING AND CORRECTING WORK 16
11.1 Uncovering Work 16
11.2 Correcting Work 16
11.3 City May Accept Defective or Nonconforming Work 17

ARTICLE XII; CONTRACT DEFAULT AND TERMINATION 17
12.1 Termination by the Contractor 17
12.2 Termination by the City 17
12.3 Use of Third-Party Oversight or Construction Manager 19

ARTICLE XIII; INSURANCE 19
13.1 Contractor Shall Maintain Insurance 19
13.2 Types and Amounts of Contractor’s Insurance 19
13.3 Additional Insured 19
13.4 Written Notification 19
13.5 Premiums and Assessments; Subrogation 20
13.6 Certificate of Insurance 20
13.7 Primary Coverage 20
13.8 Worker’s Compensation Insurance Coverage 20

ARTICLE XIV; MISCELLANEOUS 21
14.1 Laws and Ordinances 21
14.2 Governing Law 21
14.3 Successors and Assigns 21
14.4 Surety Bonds 21
14.5 Force Majeure 22
14.6 Immunities; Defenses 22
14.7 No Rights in Third Parties 22
14.8 Severability 22
14.9 Amendments; No Waiver 22
14.10 Notices 22

City of Lucas, Texas

This Agreement is made by and between the City of Lucas, Texas, a home-rule municipality (hereinafter referred to as the "City") and ***[ENTER CONTRACTOR LEGAL NAME]***, (hereinafter referred to as the "Contractor") for construction of ***[ENTER PROJECT NAME]***, (hereinafter referred to as the "Project"), the City and the Contractor hereby agreeing as follows:

ARTICLE I

THE CONTRACT AND THE CONTRACT DOCUMENTS

1.1 THE CONTRACT

1.1.1 The contract between the City and the Contractor, of which this agreement (sometimes referred to herein as the "Contract") is a part, consists of the Contract Documents. It shall be effective on the date this Agreement is executed by the last party to execute it.

1.2. THE CONTRACT DOCUMENTS

1.2.1 The Contract Documents consist of this agreement, the General Conditions, the Special Conditions, the Invitation to Bid, Requirements and Instructions to Bidders, the Specifications, the Drawings, the Shop Drawings, the Project Manual, all Change Orders and Field Orders issued hereafter, the addenda, exhibits and attachments thereto, any other amendments hereto executed by the parties hereafter, together with the following (if any):

1.3 ENTIRE AGREEMENT

1.3.1 This Contract, together with the Contractor's performance and payment bonds for the Project, all General Conditions, Special Conditions, Plans and Specifications, and Addenda attached thereto, constitute the entire and exclusive agreement between the City and the Contractor with reference to the Project. Specifically, but without limitation, this Contract supersedes any bid documents and all prior written or oral communications, representations and negotiations, if any, between the City and Contractor not expressly made a part hereof.

1.4 NO PRIVITY WITH OTHERS

1.4.1 Nothing contained in this Contract shall create, or be interpreted to create, privity or any other contractual agreement between the City and any person or entity other than the Contractor.

1.5 INTENT AND INTERPRETATION

1.5.1 The intent of this Contract is to require complete, correct and timely execution of the Work. Any Work that may be required, implied or inferred by the Contract Documents, or any one or more of them, as necessary to produce the intended result shall be provided by the Contractor for the Contract Price.

1.5.2 This Contract is intended to be an integral whole and shall be interpreted as internally consistent. What is required by any one Contract Document shall be considered as required by the Contract.

1.5.3 When a word, term or phrase is used in this Contract, it shall be interpreted or construed, first, as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage.

1.5.4 The word “City” includes the City of Lucas, Texas, a municipal corporation, and its public officials, officers, employees, agents and employees. The word “Contractor” includes the Contractor and its officers, employees, agents and representatives. The word "include", "includes", or "including", as used in this subparagraph and in this Contract, shall be deemed to be followed by the phrase, "without limitation".

1.5.5 The specification herein of any act, failure, refusal, omission, event, occurrence or condition as constituting a material breach of this Contract shall not imply that any other, non-specified act, failure, refusal, omission, event, occurrence or condition shall be deemed not to constitute a material breach of this Contract.

1.5.6 Words or terms used as nouns in this Contract shall be inclusive of their singular and plural forms, unless the context of their usage clearly requires a contrary meaning.

1.5.7 The Contractor shall have a continuing duty to read, carefully study and compare each of the Contract Documents, the Shop Drawings, the Product Data, and any Plans and Specifications, and shall give written notice to the City of any inconsistency, ambiguity, error or omission which the Contractor may discover with respect to these documents before proceeding with the affected Work. The issuance, or the express or implied approval by the City or the Engineer of the Contract Documents, Shop Drawings or Product Data, shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with this Contract. The City has requested the Engineer to only prepare documents for the Project, including the Drawings, Plans and Specifications for the Project, which are accurate, adequate, consistent, coordinated and sufficient for construction. HOWEVER, THE CITY MAKES NO REPRESENTATION OR WARRANTY OF ANY NATURE WHATSOEVER TO THE CONTRACTOR CONCERNING SUCH DOCUMENTS. THE CONTRACTOR ASSUMES ALL RISK OF ERRORS, AMBIGUITIES AND INACCURACIES. By the execution hereof, the Contractor acknowledges and represents that it has received, reviewed and carefully examined such documents, has found them to be complete, accurate, adequate, consistent, coordinated and sufficient for construction, and that the Contractor has not, does not, and will not rely upon any representation or warranties by the City concerning such documents as no such representation or warranties have been or are hereby made. Further, the Contractor represents and warrants that it has had a sufficient opportunity to inspect the Project site and assumes any and all responsibility for inadequacies or ambiguities in the plans, drawings or specifications as well as for latent conditions of the site where the work is to be performed.

1.5.8 As between numbers and scaled measurements on the Drawings and in the Design, the numbers shall govern, as between larger scale and smaller scale drawings, the larger scale shall govern.

1.5.9 Neither the organization of any of the Contract Documents into divisions, sections, paragraphs, articles, (or other categories), nor the organization or arrangement of the Design, shall control the Contractor in dividing the Work or in establishing the extent or scope of the Work to be performed by Subcontractors.

1.6 OWNERSHIP OF CONTRACT DOCUMENTS

1.6.1 The Contract Documents, and each of them individually and collectively, shall remain the property of the City. The Contractor shall have the right to keep one record set of the Contract Documents upon completion of the Project; provided, however, that in no event shall Contractor use, or permit to be used, any or all of such Contract Documents on other projects without the City's prior written authorization.

ARTICLE II

THE WORK

2.1 The Contractor shall perform all of the Work required, implied or reasonably inferable from this Contract.

2.2 WORK

2.2.1 The term "Work" shall mean whatever is done by or required of the Contractor to perform and complete its duties under this Contract, including the following: construction of the whole or a designated part of the Project; furnishing of any required surety bonds and insurance, and the provision or furnishing of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, permits and licenses required of the Contractor, power, water, fuel, heat, light, cooling and all other utilities as required by this Contract. The Work to be performed by the Contractor is generally described as follows:

Approximate quantities for ***[ENTER PROJECT NAME]*** include ***[ENTER MAJOR BID ITEMS AND QUANTITIES]***; and other miscellaneous improvements as shown on the plans and in accordance with the specifications.

2.2.2 The Contractor shall be responsible for paying for and procuring all materials and labor and furnishing all services necessary or appropriate for the full performance of the Work and the for the full completion of the Project. All materials shall be new and materials and workmanship shall be of good quality. Upon request, the Contractor shall furnish satisfactory proof of the type, kind, and quality of materials.

ARTICLE III

CONTRACT TIME

3.1 SUBSTANTIAL COMPLETION

3.1.1 "Substantial Completion" shall mean that stage in the progression of the Work when the Work is sufficiently complete in accordance with this Contract that the City can enjoy beneficial use or occupancy of the Work and can utilize the Work for its intended purpose, even though minor miscellaneous work and/or adjustment may be required.

3.2 TIME

3.2.1 The Contractor shall commence the Work within 10 days of receipt of a written Notice to Proceed, and shall achieve Substantial Completion of the Work no later than ***[ENTER NUMBER OF CALENDAR DAYS FOR PROJECT DURATION]*** calendar days from the date specified in the Notice to Proceed. The term “calendar days” shall mean any and all days of the week or month, no days being excepted. The number of calendar days from the date on which the Work is permitted to proceed, through the date set forth for Substantial Completion, shall constitute the Contract Time” and the “scheduled completion date.” The execution of this Contract by the Contractor constitutes an agreement that adequate time has been allotted for this Contract, given the Contract Price.

3.2.2 Work may proceed on any day of the week, including weekends, and at any time of the day. However, work shall not occur on such days or at such times as, in the City’s or Engineer’s discretion, may be a violation of noise or environmental regulations or ordinances, or when the presence of workers, equipment or materials may create an abnormally hazardous condition.

3.2.3 The Contractor shall submit and comply with construction schedules establishing completion timelines and deadlines for each component of the Project. Construction schedules shall be submitted to and approved by the Engineer and the City on a regular basis as required by the Contract Documents. If no reference is made to construction schedules in the Contract Documents, then construction schedules shall be submitted with each Application for Payment.

3.3 TIME IS OF THE ESSENCE

3.3.1 The scheduled completion date is based on public necessity. The scheduled completion date is factored into and is a material component of the Contract Price. All limitations of time set forth in the Contract Documents are of the essence of this Contract.

3.3.2 TIME IS OF THE ESSENCE IN THE PERFORMANCE OF THE WORK AND THE COMPLETION OF THE PROJECT ON OR BEFORE THE SCHEDULED COMPLETION DATE. THE SCHEDULED COMPLETION DATE IS A DEADLINE. THE CITY EMPLOYS A ZERO-TOLERANCE POLICY REGARDING THE TIME FOR COMPLETION. The time for completion is an essential and material term of this Contract and the Contractor's failure to achieve substantial completion on the date stated herein, to comply with work schedules, or achieve milestones in approved construction schedules, shall be a material breach and default of this Contract.

3.3.3 The City will assess liquidated damages for late or untimely performance and may, at the City's sole option, elect to allow Contractor to continue with the Work, or may declare Contractor to be in breach and default of the Contract and order Contractor to remove all equipment and personnel from the work site. All remedies for Contractor's late performance shall be nonexclusive and cumulative without waiver of any other, and the City's election of one shall not preclude the City from pursuing any other.

3.3.4 It is contemplated by the parties that the progress of the Work may be delayed by certain conditions beyond the control of the parties; these delays have been contemplated by the parties and considered in the time allotted for performance specified herein and in the contract price and includes, but is not limited to delays occasioned on account of adverse weather, temporary unavailability of materials, shipment delays, and the presence and potential interference of other contractors or of utilities that may be performing work at the Project site unrelated to this Contract. These delays have been considered and included in the determination of the scheduled completion date and the Contract Price.

3.4 LIQUIDATED DAMAGES; EARLY COMPLETION BONUS

3.4.1 The Contractor shall pay the City the sum of **$**_____ ***[ENTER DAILY LIQUIDATED DAMAGE AMOUNT]*** per day for each and every calendar day of unexcused delay in achieving Substantial Completion beyond the date set forth herein for Substantial Completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by the City, estimated at or before the time of executing this Contract. When the City reasonably believes that Substantial Completion will be inexcusably delayed, the City shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the City to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the City has withheld payment, the City shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. If the Contractor has submitted a Statement of Delay with the appropriate Application for Payment as required by Subparagraph 5.2.3, and/or has complied with the notice and Change Order requirements of this Contract, the Engineer shall have sole discretion to determine whether a delay is excused or unexcused and the Engineer's determination thereof shall be final and binding on the parties.

3.4.2 In the event that the Contractor achieves certification by the Engineer of Final Completion prior to _____ ***[ENTER DATE FOR EARLY COMPLETION BONUS]*** Calendar days from the date specified in the Notice to Proceed, the City shall pay to the Contractor the sum of **$**_____ ***[ENTER DAILY AMOUNT OF INCENTIVE]*** per day for each calendar day that Final Completion is certified in advance of the scheduled Final Completion date, as that date may be modified by written change order. However, early completion bonuses shall not, in the aggregate, exceed the total sum of $_____ ***[ENTER MAXIMUM AMOUNT OF EARLY COMPLETION BONUS]***. Any reduction in the scope of work, evidenced by written change order, shall commensurately reduce the Contract Time.

3.5 NO DAMAGES FOR DELAY; NO BACK-CHARGES; DAMAGE WAIVER

3.5.1 No claim shall be made by the Contractor to the City, and no damages, costs or extra compensation shall be allowed or paid by the City to the Contractor for any delay or hindrance from any cause in the progress or completion of the Work or this Contract. The Contractor's sole remedy in the event of any delay or hindrance, regardless of cause, shall be to request time extensions by written change orders as provided for hereinafter. The failure to seek or obtain a change order for time extension shall be deemed a waiver thereof and Contractor shall be regarded as having made a determination that the delay will not affect the completion of the Work. Should the Contractor be delayed by an act of the City, or should the City order a stoppage of the Work for sufficient cause unrelated to any act or omission of the Contractor, an extension of time shall be granted by the City by Change Order upon written application, which extension shall not be unreasonably denied, to compensate for the delay.

3.5.2 The City shall have the authority to suspend the Work wholly or in part for such period or periods of time as it may deem appropriate due to unsuitable conditions considered unfavorable for the proper prosecution of the Work or for the failure of the Contractor to carry out instructions from the City or City's representative. During any period in which the Work is stopped or during which any of the Work is not actively in progress for any reason, Contractor shall properly protect the site and the Work from damage, loss or harm. The Contractor shall not be compensated for periods of delay caused by a suspension of the work by the City. If work is suspended due to unsuitable conditions through no fault of the Contractor, an extension of time shall be granted by the City by Change Order upon written application, which extension shall not be unreasonably denied, to compensate for the delay.

3.5.3 The Contractor shall not have or assert any claim against the City for damages or back-charges of any kind for any reason, including but not limited to claims for Extra Work, damages, economic loss, additional costs, unknown latent site conditions, and refusals by the City to grant extensions of time, unless supported and authorized by a written Change Order or separate agreement signed by all parties. The Contractor, in entering into this Contract, hereby waives, releases, quitclaims, discharges and holds harmless the City from and against any and all claims, damages, liabilities and losses, save and except those arising under Paragraph 12.1 of this Contract.

ARTICLE IV

CONTRACT PRICE

4.1 THE CONTRACT PRICE

4.1.1 The City shall pay, and the Contractor shall accept, as full and complete payment for all of the Work required herein, the fixed sum of

$[ENTER CONTRACT AMOUNT].

The sum set forth in this Paragraph 4.1 shall constitute the Contract Price which shall not be modified except by written Change Order as provided in this Contract, or the assessment of liquidated damages or the award of an early completion bonus.

ARTICLE V

PAYMENT OF THE CONTRACT PRICE

5.1 SCHEDULE OF VALUES

5.1.1 The Schedule of Values, submitted to and accepted by the City and Engineer at the time of the Contractor's bid, allocates the Contract Price to the various portions of the Work. The Contractor's Schedule of Values shall have been be prepared, or at the City's or Engineer's request shall be amended prior to the commencement of construction, in such form, with such detail, and supported by such data as the Engineer or the City may require to substantiate its accuracy. The Contractor shall not imbalance its Schedule of Values nor artificially inflate any element thereof. The violation of this provision by the Contractor shall constitute a material breach of this Contract.

The Schedule of Values shall be used only as a basis for the Contractor's Applications for Payment and shall only constitute such basis after it has been acknowledged and accepted in writing by the Engineer and the City.

5.2 PAYMENT PROCEDURE

5.2.1 The City shall pay the Contract Price to the Contractor as provided below.

5.2.2 PROGRESS PAYMENTS - Based upon the Contractor's Applications for Payment submitted to the Engineer and upon Certificates for Payment subsequently issued to the City by the Engineer, the City shall make progress payments to the Contractor on account of the Contract Price.

5.2.3 APPLICATION FOR PAYMENT - On or before the 25th day of each month after commencement of the Work, the Contractor shall submit an Application for Payment for the period ending the 15th day of the month to the Engineer in such form and manner, and with such supporting data and content, as the City or the Engineer may require. The Contractor may request payment for that portion of the Contract Price properly allocable to Contract requirements properly provided and to labor, materials and equipment properly incorporated in the Work, less retainage and less the total amount of previous payments received from the City. Such Application for Payment shall be signed by the Contractor and shall constitute the Contractor's representation that the Work has progressed to the level for which payment is requested in accordance with the Schedule of Values, that the Work has been properly installed or performed in full compliance with this Contract, and that the Contractor knows of no reason why payment should not be made as requested. Thereafter, the Engineer will review the Application for Payment and may also review the Work at the Project site or elsewhere to determine whether the quantity and quality of the Work is as represented in the Application for Payment and is as required by this Contract. The Engineer shall determine and certify to the City the amount properly owing to the Contractor. The City shall make partial payments on account of the Contract Price to the Contractor within thirty (30) days following the Engineer's receipt and approval of each Application for Payment. The amount of each partial payment shall be the amount certified for payment by the Engineer less such amounts, if any, otherwise owing by the Contractor to the City or which the City shall have the right to withhold as authorized by this Contract. The Engineer's certification of the Contractor's Application for Payment shall not preclude the City from the exercise of any of its rights as set forth in Paragraph 5.3 hereinbelow.

5.2.4 STATEMENT OF DELAY - Each Application for Payment shall include a Statement of Delay showing the number of days lost due to inclement weather, conflicts with other City contractors, utilities, or design specifications, or other proper reasons. The failure to submit the Statement of Delay shall be a waiver of any claim for additional days or extensions of the scheduled completion date.

5.2.5 RETAINAGE - If the Contract Price set forth in Subparagraph 4.1.1 exceeds $400,000, the City shall withhold retainage of ten (10) percent from each progress payment to secure performance of the Contract and shall deposit in an interest-bearing account that portion of the retainage withheld that exceeds five (5) percent of the progress payment. If a different percentage is set forth in the Invitation to Bid, then that percentage shall apply.

5.2.6 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the City when installed at the Project site, regardless of the time of payment. The Contractor further warrants that upon submittal of an Application for Payment, all Work for which payments have been received from the City shall be free and clear of liens, claims, security interest or other encumbrances in favor of the Contractor or any other person or entity whatsoever.

5.2.7 The Contractor shall promptly pay each Subcontractor out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount to which such Subcontractor is entitled. In the event the City becomes informed that the Contractor has not paid a Subcontractor as herein provided, the City shall have the right, but not the duty, to issue future checks in payment to the Contractor of amounts otherwise due hereunder naming the Contractor and such Subcontractor as joint payees. Such joint check procedure, if employed by the City, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit the City to repeat the procedure in the future.

5.2.8 No progress payment, nor any use or occupancy of the Project by the City, shall be interpreted to constitute an acceptance of any Work not in strict compliance with this Contract.

5.3 WITHHELD PAYMENT

5.3.1 The City may decline to make payment, may withhold funds, and, if necessary, may demand the return of some or all of the amounts previously paid to the Contractor, to protect the City from loss because of:

(a) defective Work not remedied by the Contractor or, in the opinion of the City, likely to be remedied by the Contractor;

(b) claims of third parties against the City or the City's property;

(c) failure by the Contractor to pay Subcontractors or others in a prompt and proper fashion;

(d) evidence that the balance of the Work cannot be completed in accordance with the Contract for the unpaid balance of the Contract Price,

(e) evidence that the Work will not be completed in the time required for substantial or final completion (final completion meaning the full and final completion of all work called for by this Contract and final acceptance by the Engineer and the City);

(f) persistent failure to carry out the Work in accordance with the Contract;

(g) damage to the City or a third party to whom the City is, or may be, liable.

(h) failure to submit an updated project schedule in accordance with Subparagraph 3.2.3.

(i) failure to submit record drawings in accordance with Subparagraph 7.9.1.

In the event that the City makes written demand upon the Contractor for amounts previously paid by the City as contemplated in this Subparagraph 5.3.1, the Contractor shall promptly comply with such demand. The City shall have no duty to third parties to withhold payment to the Contractor and shall incur no liability for a failure to withhold funds.

5.4 UNEXCUSED FAILURE TO PAY

5.4.1 If within twenty (20) days after the date established herein for payment to the Contractor by the City, the City, without cause or basis hereunder, fails to pay the Contractor any amount then due and payable to the Contractor, then the Contractor may after ten (10) additional days' written notice to the City and the Engineer, and without prejudice to any other available rights or remedies it may have, stop the Work until payment of those amounts due from the City have been received. Late payments shall not accrue interest or other late charges.

5.5 CERTIFICATE OF SUBSTANTIAL COMPLETION

5.5.1 When the Contractor believes that the Work is substantially complete, the Contractor shall submit to the Engineer a list of items to be completed or corrected. When the Engineer and the City on the basis of an inspection determine that the Work is in fact substantially complete, the Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall state the responsibilities of the City and the Contractor for Project security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed therein. In no event, however, shall the date of Final Completion be delayed. Guarantees required by the Contract shall commence on the date of Substantial Completion of the Work; however, the maintenance bond required herein, and the assurances given thereunder, shall commence of and from the date of final acceptance of the work by the City. The Certificate of Substantial Completion shall be submitted to the City and the Contractor for their written acceptance of the responsibilities assigned to them in such certificate.

Upon Substantial Completion of the Work, and execution by both the City and the Contractor of the Certificate of Substantial Completion, the City shall pay the Contractor for all work completed to date, less retainage.

5.6 COMPLETION AND FINAL PAYMENT

5.6.1 When all of the Work is finally complete and the Contractor is ready for a final inspection, it shall notify the City and the Engineer thereof in writing. Thereupon, the Engineer will make final inspection of the Work and, if the Work is complete in full accordance with this Contract and this Contract has been fully performed, the Engineer will promptly issue a final Certificate for Payment certifying to the City that the Project is complete and the Contractor is entitled to the remainder of the unpaid Contract Price (including retainage and the interest accrued on the retainage in excess of five (5) percent if the Contract Price is in excess of $400,000), plus an early completion bonus, if any, less any amount withheld pursuant to this Contract. If the Engineer is unable to issue its final Certificate for Payment and is required to repeat its final inspection of the Work, the Contractor shall bear the cost of such repeat final inspection(s) which cost may be deducted by the City from the Contractor's final payment.

5.6.1.1 If the Contractor fails to achieve final completion within the time fixed therefor by the Engineer in its Certificate of Substantial Completion, the Contractor shall pay the City the sum set forth hereinabove as liquidated damages per day for each and every calendar day of unexcused delay in achieving final completion beyond the date set forth herein for final completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by the City, estimated at or before the time of executing this Contract. When the City reasonably believes that final completion will be inexcusably delayed, the City shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the City to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving final completion, or any part thereof, for which the City has withheld payment, the City shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. Liquidated damages shall be deducted first from any earned early completion bonus, then from any sums otherwise due to the Contractor.

5.6.2 The Contractor shall not be entitled to final payment unless and until it submits to the Engineer its affidavit that all payrolls, invoices for materials and equipment, and other liabilities connected with the Work for which the City, or the City's property might be responsible, have been fully paid or otherwise satisfied; releases and waivers of lien from all Subcontractors of the Contractor and of any and all other parties required by the Engineer or the City; consent of Surety, if any, to final payment. If any third party fails or refuses to provide a release of claim or waiver of lien as required by the City, the Contractor shall furnish a bond satisfactory to the City to discharge any such lien or indemnify the City from liability.

5.6.3 The City shall make final payment of all sums due the Contractor within thirty (30) days of the Engineer's execution of a final Certificate for Payment.

5.6.4 Acceptance of final payment shall constitute a waiver of all claims against the City by the Contractor except for those claims previously made in writing against the City by the Contractor, pending at the time of final payment, and identified in writing by the Contractor as unsettled at the time of its request for final payment.

5.6.5 Other than interest on retainage in excess of 5% under Paragraph 5.2.5, under no circumstances shall Contractor be entitled to receive interest on any payments or monies due Contractor by the City, whether the amount on which the interest may accrue is timely, late, wrongfully withheld, or an assessment of damages of any kind.

ARTICLE VI

THE CITY

6.1 INFORMATION, SERVICES AND THINGS REQUIRED FROM CITY

6.1.1 The City shall furnish to the Contractor, at the time of executing this Contract, any and all written and tangible material in its possession concerning conditions below ground at the site of the Project. Such written and tangible material is furnished to the Contractor only in order to make complete disclosure of such material and for no other purpose. By furnishing such material, the City does not represent, warrant, or guarantee its accuracy either in whole, in part, implicitly or explicitly, or at all, and shall have no liability therefor. The City shall also furnish surveys, legal limitations and utility locations (if known), and a legal description of the Project site.

6.1.2 Excluding permits and fees normally the responsibility of the Contractor, the City shall obtain all approvals, easements, and the like required for construction and shall pay for necessary assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

6.1.3 The City shall furnish the Contractor, free of charge, two copies of the Contract Documents for execution of the Work.

6.2 RIGHT TO STOP WORK

6.2.1 If the Contractor persistently fails or refuses to perform the Work in accordance with this Contract, if the Contractor fails to meet milestones set forth in approved construction schedules, if the City has sufficient reason to believe that the Contractor is not and will not complete the Project by the scheduled completion date, or if the best interests of the public health, safety or welfare so require, the City may order the Contractor to stop the Work, or any described portion thereof, until the cause for stoppage has been corrected, no longer exists, or the City orders that Work be resumed. In such event, the Contractor shall immediately obey such order.

6.3 CITY'S RIGHT TO PERFORM WORK

6.3.1 If the Contractor's Work is stopped by the City under Paragraph 6.2, and the Contractor fails within seven (7) days of such stoppage to provide adequate assurance to the City that the cause of such stoppage will be eliminated or corrected, then the City may, without prejudice to any other rights or remedies the City may have against the Contractor, proceed to carry out the subject Work. In such a situation, an appropriate Change Order shall be issued deducting from the Contract Price the cost of correcting the subject deficiencies, plus compensation for the Engineer's additional services and expenses necessitated thereby, if any. If the unpaid portion of the Contract Price is insufficient to cover the amount due the City, the Contractor shall pay the difference to the City.

ARTICLE VII THE

CONTRACTOR

7.1 MUST FOLLOW CONTRACT

7.1.1 The Contractor shall perform no part of the Work at any time without adequate Contract Documents or, as appropriate, approved Shop Drawings, Product Data or Samples for such portion of the Work. If the Contractor performs any of the Work knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Engineer, the Contractor shall bear responsibility for such performance and shall bear the cost of correction. The Contractor shall perform the Work strictly in accordance with this Contract

7.2 PROSECUTION OF WORK

7.3.1 The Contractor shall supervise and direct the Work using the Contractor's best skill, effort and attention. The Contractor shall be responsible to the City for any and all acts or omissions of the Contractor, its employees and others engaged in the Work on behalf of the Contractor.

7.3.2 The Contractor shall give adequate attention to the faithful prosecution of the Work and the timely completion of this Contract, with authority to determine the manner and means of performing such Work, so long as such methods insure timely completion and proper performance.

7.3.3 The Contractor shall exercise all appropriate means and measures to insure a safe and secure jobsite in order to avoid and prevent injury, damage or loss to persons or property.

7.3.4 The City will not interfere with the Contractor's manner and means of performing the Work. However, the City's insistence on strict compliance with the Contract shall not be regarded as an interference with the Contractor's manner and means. In the event that any part of the Work is not in strict compliance with the Contract, the Contractor is and shall be estopped from claiming any interference by the City or Engineer with the Contractor's manner and means of performing that part of the Work.

7.4 WARRANTY

7.4.1 The Contractor warrants to the City that all labor furnished to progress the Work under this Contract will be competent to perform the tasks undertaken, that the product of such labor will yield only first-class results, that materials and equipment furnished will be of good quality and new unless otherwise permitted by this Contract, and that the Work will be of good quality, free from faults and defects and in strict conformance with this Contract. All Work not conforming to these requirements may be considered defective. THE CONTRACTOR WARRANTS AND GUARANTIES THAT IT SHALL COMPLETE THE WORK AND ACHIEVE SUBSTANTIAL COMPLETION BY THE SCHEDULED COMPLETION DATE, STRICTLY IN ACCORDANCE WITH THIS CONTRACT. DEFECTIVE WORK OR MATERIALS SHALL BE FIXED, REPAIRED OR REPLACED FREE OF CHARGE OR COST TO THE CITY.

7.5 PERMITS; FEES; LICENSES

The Contractor shall obtain and pay for all permits, fees and licenses necessary and ordinary for the Work. The Contractor shall comply with all lawful requirements applicable to the Work and shall give and maintain any and all notices required by applicable law pertaining to the Work.

7.6 SUPERVISION

7.6.1 The Contractor shall employ and maintain at the Project site only competent supervisory personnel. Absent written instruction from the Contractor to the contrary, the superintendent shall be deemed the Contractor's authorized representative at the site and shall be authorized to receive and accept any and all communications from the City or the Engineer.

7.6.2 Key supervisory personnel assigned by the Contractor to this Project are as follows:

NAME	**FUNCTION**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

So long as the individuals named above remain actively employed or retained by the Contractor, they shall perform the functions indicated next to their names unless the City agrees to the contrary in writing. In the event one or more

individuals not listed above subsequently assume one or more of those functions listed above, the Contractor shall be bound by the provisions of this Subparagraph 7.6.2 as though such individuals had been listed above.

7.7 WORK SCHEDULE

7.7.1 At the pre-construction meeting, the Contractor shall submit to the City and the Engineer for their information, the Contractor's schedule for completing the Work (also referred to herein as the construction schedule). The Contractor's schedule shall be revised no less frequently than monthly (unless the parties otherwise agree in writing) and shall be revised to reflect conditions encountered from time to time and shall be related to the entire Project. Each such revision shall be furnished to the City and the Engineer.

7.7.2 The Contractor's schedule for completing the Work and any revised schedules, shall demonstrate achievement of substantial completion by the scheduled completion date. Failure by the Contractor to strictly comply with the provisions of this Paragraph 7.7 shall constitute a default and a material breach of this Contract.

7.8 ON-SITE DRAWINGS

7.8.1 The Contractor shall continuously maintain at the site, for the benefit of the City and the Engineer, one record copy of this Contract marked to record on a current basis changes, selections and modifications made during construction. Additionally, the Contractor shall maintain at the site for the City and Engineer the approved Shop Drawings, Product Data, Samples and other similar required submittals. Upon final completion of the Work, all of these record documents shall be delivered to the City.

7.9 RECORD DRAWINGS/PLANS, AS-BUILT PLANS, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

7.9.1 The Contractor shall submit, with each Application for Payment, As-Built plans for any and each part or portion of the Project that varies from the Engineer's plans and specifications and the Contract Documents.

7.9.2 Shop Drawings, Product Data, Samples and other submittals from the Contractor do not constitute Contract Documents. Their purpose is merely to demonstrate the manner in which the Contractor intends to implement the Work in conformance with information received from the Contract Documents.

7.9.3 The Contractor shall not perform any portion of the Work requiring submittal and review of Shop Drawings, Product Data or Samples unless and until such submittal shall have been approved by the Engineer. Approval by the Engineer, however, shall not be evidence that Work installed pursuant thereto conforms to the requirements of this Contract.

7.10 CLEANING THE SITE AND THE PROJECT

7.10.1 The Contractor shall keep the site reasonably clean during performance of the Work. The Contractor shall clean the site and the Project and remove all waste, rubbish, temporary structures, and other materials during construction and, upon completion of construction, shall clean the site and remove all such material together with all of the Contractor's property therefrom. Contractor shall dispose of all refuse at a landfill approved by the Texas Commission on Environmental Quality. The Contractor shall further restore all property damaged during the prosecution of the Work and shall leave the site in a clean and presentable condition. No additional payment shall be made by the City for this work, the compensation having been considered and included in the contract price.

7.11 ACCESS TO WORK AND INSPECTIONS

7.11.1 The City and the Engineer shall have access to the Work at all times from commencement of the Work through final completion. The Contractor shall take whatever steps necessary to provide access when requested. When reasonably requested by the City or the Engineer, the Contractor shall perform or cause to be performed such testing as may be necessary or appropriate to insure suitability of the jobsite or the Work's compliance with the Contract requirements.

7.12 INDEMNITY AND DISCLAIMER

7.12.1 CITY SHALL NOT BE LIABLE OR RESPONSIBLE FOR, AND SHALL BE INDEMNIFIED, DEFENDED, HELD HARMLESS AND RELEASED BY CONTRACTOR FROM AND AGAINST ANY AND ALL SUITS, ACTIONS, LOSSES, DAMAGES, CLAIMS, OR LIABILITY OF ANY CHARACTER, TYPE, OR DESCRIPTION, INCLUDING ALL EXPENSES OF LITIGATION, COURT COSTS, AND ATTORNEY'S FEES, FOR INJURY OR DEATH TO ANY PERSON, INJURY OR LOSS TO ANY PROPERTY, OR ECONOMIC LOSS, RECEIVED OR SUSTAINED BY ANY PERSON OR PERSONS, INCLUDING THE CONTRACTOR, OR PROPERTY, DIRECTLY OR INDIRECTLY ARISING OUT OF, OR OCCASIONED BY THE PERFORMANCE OF CONTRACTOR UNDER THIS CONTRACT, INCLUDING CLAIMS AND DAMAGES ARISING IN WHOLE OR IN PART FROM THE NEGLIGENCE OF CITY, WITHOUT WAIVING THE CITY'S GOVERNMENTAL, SOVEREIGN OR OTHER IMMUNITIES OR DEFENSES AVAILABLE TO THE CITY UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW. IT IS THE EXPRESS INTENT OF THE PARTIES TO THIS CONTRACT THAT THE INDEMNITY PROVIDED FOR HEREIN IS AN INDEMNITY EXTENDED BY CONTRACTOR TO INDEMNIFY AND PROTECT CITY FROM THE CONSEQUENCES OF THE CONTRACTOR'S AS WELL AS THE CITY'S NEGLIGENCE, WHETHER SUCH NEGLIGENCE IS THE SOLE OR PARTIAL CAUSE OF ANY SUCH INJURY, DEATH, OR DAMAGE.

The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

7.12.2 The Contractor will secure and maintain contractual liability insurance to cover this indemnification agreement that will be primary and non-contributory as to any insurance maintained by the City for its own benefit, including self-insurance. In addition, Contractor shall obtain and file with City a standard form Certificate of Insurance evidencing the required coverage.

7.12.3 In claims against any person or entity indemnified under this Paragraph 7.12 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Paragraph 7.12 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

7.13 NONDISCRIMINATION

7.13.1 The Contractor shall not discriminate in any way against any person, employee or job applicant on the basis of race, color, creed, national original, religion, age, sex, or disability where reasonable accommodations can be effected to enable the person to perform the essential functions of the job. The Contractor shall further insure that the foregoing nondiscrimination requirement shall be made a part and requirement of each subcontract on this Project.

7.14 PREVAILING WAGE RATES

7.14.1 The Contractor shall comply in all respects with all requirements imposed by any laws, ordinances or resolutions applicable to the Project with regard to the minimum prevailing wage rates for all classes of employees, laborers, subcontractors, mechanics, workmen and persons furnishing labor and services to the Project. The City has adopted a Prevailing Wage Rate Schedule, available to the Contractor by request (or attached to this contract as a part of the exhibits), which specifies the classes and wage rates to be paid to all persons. The Contractor shall pay not less than the minimum wage rates established thereby for each class, craft or type of labor, workman, or

mechanic employed in the execution of this Contract. The failure of the Contractor to comply with this requirement shall result in the forfeiture to the City of a sum of not less than Sixty Dollars ($60.00) for each person per day, or portion thereof, that such person is paid less than the prevailing rate. Upon request by the City, Contractor shall make available for inspection and copying its books and records, including but not limited to its payroll records, account information and other documents as may be required by the City to insure compliance with this provision.

7.15 JOB SITE SAFETY PRECAUTIONS

7.15.1 The Contractor shall at all times exercise reasonable precautions for the safety of its employees, laborers, subcontractors, mechanics, workmen and others on and near the jobsite and shall comply with all laws, ordinances, regulations, and standards of federal, state and local safety laws and regulations. The Contractor shall provide such machinery guards, safe walk-ways, ladders, bridges, and other safety devices as may be necessary or appropriate to insure a safe and secure jobsite and shall require its subcontractors to comply with this requirement. The Contractor shall immediately comply with any and all safety requirements imposed by the Engineer during the progress of the Work.

7.16 WARNING DEVICES AND BARRICADES

7.16.1 The Contractor shall furnish and maintain such warning devices, barricades, lights, signs, pavement markings, and other devices as may be necessary or appropriate or required by the Engineer to protect persons or property in, near or adjacent to the jobsite. No separate compensation shall be paid to the Contractor for such measures. Where the Work is being conducted in, upon or near streets, alleys, sidewalks, or other rights-of-way, the Contractor shall insure the placement, maintenance and operation of any and all such warning devices as may be required by the City and shall do so until no longer required by the City. Such devices shall be in compliance with and conform to the manual and specifications for the uniform system of traffic control devices adopted by the Texas Department of Transportation.

7.17 PROTECTION OF UTILITIES AND OTHER CONTRACTORS

7.17.1 The Contractor shall use best efforts to leave undisturbed and uninterrupted all utilities and utility services provided to the jobsite or which presently exists at, above or beneath the location where the Work is to be performed. In the event that any utility or utility service is disturbed or damaged during the progress of the Work, the Contractor shall forthwith repair, remedy or restore the utility at Contractor's sole expense. The Contractor shall coordinate any utility conflicts with the owner of the utility and no extension of time will be requested or given if adequate coordination is not provided by Contractor.

7.17.2 The Contractor understands and acknowledges that other contractors of the City or of other entities may be present at the jobsite performing other work unrelated to the Project. The Contractor shall use best efforts to work around other contractors without impeding the work of others while still adhering to the scheduled completion date. In the event that the Contractor's work is or may be delayed by any other person, the Contractor shall immediately give notice thereof to the Engineer and shall request a written Change Order in accordance with the procedures set forth by this Contract. The Contractor's failure to provide such notice and to request such Change Order shall constitute a waiver of any and all claims associated therewith.

ARTICLE VIII CONTRACT

ADMINISTRATION

8.1 THE ENGINEER

8.1.1 When used in this Contract the term "Engineer" does not necessarily denote a duly licensed, trained or certified engineer; as used herein, the term shall be used interchangeably and shall mean a designated Engineer, Engineer, or Contract Administrator (who may not be an architect or engineer) for the City, said person to be

designated or re-designated by the City prior to or at any time during the Work hereunder. The Engineer may be an employee of the City or may be retained by the City as an independent contractor but, in either event, the Engineer's duties and authority shall be as set forth hereinafter. The Contractor understands and agrees that it shall abide by the decisions and instructions of the Engineer notwithstanding the contractual relationship between the City and Engineer, the title of Contract Administrator, or the fact that the Engineer is an employee of the City.

In the event the City should find it necessary or convenient to replace the Engineer, the City shall retain a replacement Engineer and the status of the replacement Engineer shall be that of the former Engineer.

8.2 ENGINEER'S ADMINISTRATION

8.2.1 The Engineer, unless otherwise directed by the City in writing, will perform those duties and discharge those responsibilities allocated to the Engineer as set forth in this Contract. The Engineer shall be the City's representative from the effective date of this Contract until final payment has been made.

8.2.2 The City and the Contractor shall communicate with each other in the first instance through the Engineer.

8.2.3 The Engineer shall be the initial interpreter of the requirements of the drawings and specifications and the judge of the performance thereunder by the Contractor. The Engineer shall render written or graphic interpretations necessary for the proper execution or progress of the Work with reasonable promptness on request of the Contractor.

8.2.4 The Engineer will review the Contractor's Applications for Payment and will certify to the City for payment to the Contractor, those amounts then due the Contractor as provided in this Contract.

8.2.5 The Engineer shall have authority to reject Work which is defective or does not conform to the requirements of this Contract. If the Engineer deems it necessary or advisable, the Engineer shall have authority to require additional inspection or testing of the Work for compliance with Contract requirements.

8.2.6 The Engineer will review and approve, or take other appropriate action as necessary, concerning the Contractor's submittals including Shop Drawings, Product Data and Samples. Such review, approval or other action shall be for the sole purpose of determining conformance with the design concept and information given through the Contract Documents.

8.2.7 The Engineer will prepare Change Orders and may authorize minor changes in the Work by Field Order as provided elsewhere herein.

8.2.8 The Engineer shall, upon written request from the Contractor, conduct inspections to determine the date of Substantial Completion and the date of final completion, will receive and forward to the City for the City's review and records, written warranties and related documents required by this Contract and will issue a final Certificate for Payment upon compliance with the requirements of this Contract.

8.2.9 The Engineer's decisions in matters relating to aesthetic effect shall be final if consistent with the intent of this Contract.

8.3 CLAIMS BY THE CONTRACTOR

8.3.1 The Engineer shall determine all claims and matters in dispute between the Contractor and City with regard to the execution, progress, or sufficiency of the Work or the interpretation of the Contract Documents, including but not limited to the plans and specifications. Any dispute shall be submitted in writing to the Engineer within seven (7) days of the event or occurrence or the first appearance of the condition giving rise to the claim or dispute and the Engineer shall render a written decision within a reasonable time thereafter. The Engineer's decisions shall be final and binding on the parties. In the event that either party objects to the Engineer's determination as to any submitted dispute, that party shall submit a written objection to the Engineer and the opposing party within ten (10) days of receipt of the Engineer's written determination in order to preserve the objection. Failure to so object shall constitute a waiver of the objection for all purposes.

8.3.2 Pending final resolution of any claim of the Contractor, the Contractor shall diligently proceed with performance of this Contract and the City shall continue to make payments to the Contractor in accordance with this Contract.

8.3.3 CLAIMS FOR CONCEALED, LATENT OR UNKNOWN CONDITIONS - The Contractor expressly represents that it has been provided with an adequate opportunity to inspect the Project site and thoroughly review the Contract Documents and plans and specifications prior to submission of its bid and the City's acceptance of the bid. Subject to the conditions hereof, Contractor assumes full responsibility and risk for any concealed, latent or unknown condition which may affect the Work. No claims for extra work or additional compensation shall be made by Contractor in connection with concealed, latent or unknown conditions except as expressly provided herein. Should concealed, latent or unknown conditions encountered in the performance of the Work (a) below the surface of the ground or (b) in an existing structure be at variance with the conditions indicated by this Contract, or should unknown conditions of an unusual nature differing materially from those ordinarily encountered in the area and generally recognized as inherent in Work of the character provided for in this Contract, be encountered, the Contract Price shall be equitably adjusted by Change Order upon the written notice and claim by either party made within seven (7) days after the first observance of the condition. As a condition precedent to the City having any liability to the Contractor for concealed or unknown conditions, the Contractor must give the City and the Engineer written notice of, and an opportunity to observe, the condition prior to disturbing it. The failure by the Contractor to make the written notice and claim as provided in this Subparagraph shall constitute a waiver by the Contractor of any claim arising out of or relating to such concealed, latent or unknown condition and the Contractor thereby assumes all risks and additional costs associated therewith.

8.4 EXTRA WORK

8.4.1 The Contractor shall not claim, request or demand any sum from the City for Extra Work or for additional costs, and hereby waives all such claims, requests and demands and any right to assert same, unless the conditions of this subparagraph are strictly complied with. "Extra Work" is defined herein to mean any labor, service, materials, equipment, supplies or charges that are directly or indirectly related to the Work, the Project or the Project site, that is not necessarily or fairly required or implied by the Contract Documents.

8.4.2 The parties acknowledge and agree that there shall be no payment made by the City to the Contractor without a written agreement (either a separate contract or a written Change Order) signed by the parties. Should the Contractor perform Extra Work or be requested to perform Extra Work by the Engineer or City, it shall be the Contractor's obligation and duty to first apply for and obtain a written Change Order, approved by the Engineer and executed by the City. The Contractor's failure to obtain a written, signed Change Order prior to commencement of Extra Work shall constitute a complete and final waiver of any right for compensation for the Extra Work.

8.5 CLAIMS FOR ADDITIONAL COSTS OR TIME; CONTRACT PRICE INCREASE

8.5.1 If the Contractor wishes to make a claim for an increase in the Contract Price, as a condition precedent to any liability of the City therefor, the Contractor shall give the Engineer written notice of such claim within seven (7) days after the occurrence of the event, or the first appearance of the condition, giving rise to such claim. Such notice shall be given by the Contractor before proceeding to execute any additional or changed Work. The failure by the Contractor to give such notice and to give such notice prior to executing the Work shall constitute a waiver of any right to or claim for additional compensation.

8.5.2 In connection with any claim by the Contractor against the City for compensation in excess of the Contract Price, any liability of the City for the Contractor's costs shall be strictly limited to direct costs incurred by the Contractor and shall in no event include indirect costs or consequential damages of the Contractor. The City shall not be liable to the Contractor for claims of third parties, including Subcontractors. The City shall not be liable to the Contractor for any claims based upon delay to the Contractor for any reason whatsoever including any act or neglect on the part of the City.

8.5.3 If the Contractor is delayed in progressing any task which at the time of the delay is then critical or which during the delay becomes critical, as the sole result of any act or neglect to act by the City or someone acting in the City's behalf, or by changes ordered in the Work, unusual delay in transportation, unusually adverse weather

conditions not reasonably anticipated, fire or any causes beyond the Contractor's control, then the date for achieving Substantial Completion of the Work shall be extended upon the written notice and claim of the Contractor to the City and the Engineer, for such reasonable time as the Engineer may determine. Any notice and claim for an extension of time by the Contractor shall be made not more than seven (7) days after the occurrence of the event or the first appearance of the condition giving rise to the claim and shall set forth in detail the Contractor's basis for requiring additional time in which to complete the Project. In the event the delay to the Contractor is a continuing one, only one notice and claim for additional time shall be necessary. If the Contractor fails to make such claim as required in this Subparagraph, any claim for an extension of time shall be waived. The procedures and remedies provided by this provision shall be the sole remedy of Contractor and Contractor shall not assert nor be entitled to any additional delays or damages associated therewith.

8.6 FIELD ORDERS

8.6.1 The Engineer shall have authority to order minor changes in the Work not involving a change in the Contract Price or in Contract Time and not inconsistent with the intent of the Contract. Such changes shall be effected by Field Order and shall be binding upon the Contractor. The Contractor shall carry out such Field Orders promptly.

8.7 MEDIATION

8.7.1 In the event that a dispute arises under the terms of this Contract, following an adverse determination by the Engineer and proper preservation of the issue as required herein, the parties agree to submit to mediation. In such event, the parties shall agree to a designated person to serve as mediator and each party shall be responsible for payment of one-half of the total mediation fees. The parties shall submit the dispute to mediation as soon as practical and in no event later than one (1) year after the Engineer's written decision on the matter. At least one designated representative of each party must attend and participate in good faith in an effort to resolve the matters in dispute.

8.7.2 In no event shall the foregoing provision justify or authorize any delay in the progress of the Work; the parties shall abide by the decision of the Engineer in accomplishing the timely completion of the Project.

ARTICLE IX

SUBCONTRACTORS

9.1 DEFINITION

9.1.1 A Subcontractor is a person or entity that has a direct contract with the Contractor to perform a portion of the Work. No Subcontractor shall be in privity with the City.

9.2 AWARD OF SUBCONTRACTS

9.2.1 Upon execution of the Contract, the Contractor shall furnish the City, in writing, the names of persons or entities proposed by the Contractor to act as a Subcontractor on the Project. The City shall promptly reply to the Contractor, in writing, stating any objections the City may have to such proposed Subcontractor. The Contractor shall not enter into a subcontract with a proposed Subcontractor with reference to whom the City has made timely objection. The Contractor shall not be required to subcontract with any party to whom the Contractor has objection.

9.2.2 All subcontracts shall afford the Contractor rights against the Subcontractor which correspond to those rights afforded to the City against the Contractor herein, including those rights afforded to the City by Subparagraph 12.2.1 below. All subcontracts shall incorporate by reference the provisions hereof and shall provide that no claims, causes or demands shall be made by any Subcontractor against the City.

9.2.3 The Contractor shall indemnify, defend and hold harmless the City from and against any and all claims, demands, causes of action, damage, and liability asserted or made against the City by or on behalf of any Subcontractor.

ARTICLE X CHANGES IN

THE WORK

10.1 CHANGES PERMITTED

10.1.1 Changes in the Work within the general scope of this Contract, consisting of additions, deletions, revisions, or any combination thereof, may be ordered without invalidating this Contract, by Change Order or by Field Order.

10.1.2 Changes in the Work shall be performed under applicable provisions of this Contract and the Contractor shall proceed promptly with such changes.

10.2 CHANGE ORDER DEFINED

10.2.1 Change Order shall mean a written order to the Contractor executed by the City and the Engineer, issued after execution of this Contract, authorizing and directing a change in the Work or an adjustment in the Contract Price or the Contract Time, or any combination thereof. The Contract Price and the Contract Time may be changed only by written Change Order.

10.3 CHANGES IN THE CONTRACT PRICE

10.3.1 Any change in the Contract Price resulting from a Change Order shall be determined as follows: (a) by mutual agreement between the City and the Contractor as evidenced by (1) the change in the Contract Price being set forth in the Change Order, (2) such change in the Contract Price, together with any conditions or requirements related thereto, being initialed by both parties, and (3) the Contractor's execution of the Change Order, or (b) if no mutual agreement occurs between the City and the Contractor, then, as provided in Subparagraph 10.3.2 below.

10.3.2 If no mutual agreement occurs between the City and the Contractor as contemplated in Subparagraph 10.3.1 above, the change in the Contract Price, if any, shall then be determined by the Engineer on the basis of the reasonable expenditures or savings of those performing, deleting or revising the Work attributable to the change, including, in the case of an increase or decrease in the Contract Price, a reasonable allowance for direct job site overhead and profit. In such case, the Contractor shall present, in such form and with such content as the City or the Engineer require, an itemized accounting of such expenditures or savings, plus appropriate supporting data for inclusion in a Change Order. Reasonable expenditures or savings shall be limited to the following: reasonable costs of materials, supplies, or equipment including delivery costs, reasonable costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance, reasonable rental costs of machinery and equipment exclusive of hand tools whether rented from the Contractor or others, reasonable costs of premiums for all bonds and insurance, permit fees, and sales, use or other taxes related to the Work, and reasonable cost of direct supervision and jobsite field office overhead directly attributable to the change. In no event shall any expenditure or savings associated with the Contractor's home office or other non-jobsite overhead expense be included in any change in the Contract Price. Pending final determination of reasonable expenditures or savings to the City, payments on account shall be made to the Contractor on the Engineer's Certificate for Payment.

10.3.3 If unit prices are provided in the Contract, and if the quantities contemplated are so changed in a proposed Change Order that application of such unit prices to the quantities of Work proposed will cause substantial inequity to the City or to the Contractor, the applicable unit prices shall be equitably adjusted.

10.4 MINOR CHANGES

10.4.1 The Engineer shall have authority to order minor changes in the Work not involving a change in the Contract Price or an extension of the Contract Time and not inconsistent with the intent of this Contract. Such minor changes shall be made by written Field Order, and shall be binding upon the City and the Contractor. The Contractor shall promptly carry out such written Field Orders.

10.5 EFFECT OF EXECUTED CHANGE ORDER

10.5.1 The execution of a Change Order by the Contractor shall constitute conclusive evidence of the Contractor's agreement to the ordered changes in the Work, this Contract as thus amended, the Contract Price and the Contract Time. The Contractor, by executing the Change Order, waives and forever releases any claim against the City for additional time or compensation for matters relating to or arising out of or resulting from the Work included within or affected by the executed Change Order.

10.6 NOTICE TO SURETY; CONSENT

10.6.1 The Contractor shall notify and obtain the consent and approval of the Contractor's surety with reference to all Change Orders if such notice, consent or approval are required by the Contractor's surety or by law. The Contractor's execution of the Change Order shall constitute the Contractor's warranty to the City that the surety has been notified of and consents to, such Change Order and the surety shall be conclusively deemed to have been notified of such Change Order and to have expressly consented thereto.

ARTICLE XI

UNCOVERING AND CORRECTING WORK

11.1 UNCOVERING WORK

11.1.1 If any of the Work is covered contrary to the Engineer's request or to any provisions of this Contract, it shall, if required by the Engineer or the City, be uncovered for the Engineer's inspection and shall be properly replaced at the Contractor's expense without change in the Contract Time or Contract Price.

11.1.2 If any of the Work is covered in a manner consistent with the Engineer’s request or the provisions of this Contract, it shall, if required by the Engineer or City, be uncovered for the Engineer's inspection. If such Work conforms strictly to this Contract, costs of uncovering and proper replacement shall by Change Order be charged to the City. If such Work does not strictly conform to this Contract, the Contractor shall pay the costs of uncovering and proper replacement.

11.2 CORRECTING WORK

11.2.1 The Contractor shall immediately proceed to correct Work rejected by the Engineer as defective or failing to conform to this Contract. The Contractor shall pay all costs and expenses associated with correcting such rejected Work, including any additional testing and inspections, and reimbursement to the City for the Engineer's services and expenses made necessary thereby.

11.2.2 If within four (4) years after Substantial Completion of the Work any of the Work is found to be defective or not in accordance with this Contract, the Contractor shall correct it promptly upon receipt of written notice from the City. This obligation shall survive final payment by the City and termination of this Contract. With respect to Work first performed and completed after Substantial Completion, this four year obligation to specifically correct defective and nonconforming Work shall be extended by the period of time which elapses between Substantial Completion and completion of the subject Work.

11.2.3 Nothing contained in this Paragraph 11.2 shall establish any period of limitation with respect to other obligations which the Contractor has under this Contract. Establishment of the four year time period in Subparagraph 11.2.2 relates only to the duty of the Contractor to specifically correct the Work.

11.3 CITY MAY ACCEPT DEFECTIVE OR NONCONFORMING WORK

11.3.1 If the City chooses to accept defective or nonconforming Work, the City may do so at its sole discretion. In such event, the Contract Price shall be reduced by the greater of (a) the reasonable cost of removing and correcting the defective or nonconforming Work, and (b) the difference between the fair market value of the Project as constructed and the fair market value of the Project had it not been constructed in such a manner as to include defective or nonconforming Work. If the remaining portion of the unpaid Contract Price, if any, is insufficient to compensate the City for its acceptance of defective or nonconforming Work, the Contractor shall, upon written demand from the City, pay the City such remaining compensation for accepting defective or nonconforming Work.

ARTICLE XII

CONTRACT DEFAULT AND TERMINATION

12.1 TERMINATION BY THE CONTRACTOR

12.1.1 If the Work is stopped for a period of ninety (90) days by an order of any court or other public authority, or as a result of an act of the Government, through no fault of the Contractor or any person or entity working directly or indirectly for the Contractor, the Contractor may, upon fifteen (15) days' written notice to the City and the Engineer, terminate performance under this Contract and recover from the City payment for the actual reasonable expenditures of the Contractor (as limited in Subparagraph 10.3.2 above) for all Work executed and for materials, equipment, tools, construction equipment and machinery actually purchased or rented solely for the Work, less any salvage value of any such items.

12.1.2 If the City shall persistently or repeatedly fail to perform any material obligation to the Contractor for a period of fifteen (15) days after receiving written notice from the Contractor of its intent to terminate hereunder, the City shall have fifteen (15) days to remedy its failure and if not so cured, the Contractor may terminate performance under this Contract by written notice to the Engineer and the City. In such event, the Contractor shall be entitled to recover from the City as though the City had terminated the Contractor's performance under this Contract for convenience pursuant to Subparagraph 12.2.1 hereunder.

12.2 TERMINATION BY THE CITY

12.2.1 FOR CONVENIENCE

12.2.1.1 The City may for any reason whatsoever terminate performance under this Contract by the Contractor for convenience. The City shall give written notice of such termination to the Contractor specifying when termination becomes effective.

12.2.1.2 The Contractor shall incur no further obligations in connection with the Work and the Contractor shall stop Work when such termination becomes effective. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders. The City may direct the Contractor to assign the Contractor's right, title and interest under terminated orders or subcontracts to the City or its designee.

12.2.1.3 The Contractor shall transfer title and deliver to the City such completed or partially completed Work and materials, equipment, parts, fixtures, information and Contract rights as the Contractor has.

12.2.1.4 (a) The Contractor shall submit a termination claim to the City and the Engineer specifying the amounts due because of the termination for convenience together with costs, pricing or other data required by the Engineer. If the Contractor fails to file a termination claim within one (1) year from the effective date of termination, the City shall pay the Contractor, an amount derived in accordance with subparagraph (c) below.

(b) The City and the Contractor may agree to the compensation, if any, due to the Contractor hereunder.

(c) Absent agreement to the amount due to the Contractor, the City shall pay the Contractor the following amounts:

(i) Contract prices for labor, materials, equipment and other services accepted under this Contract;

(ii) Reasonable costs incurred in preparing to perform and in performing the terminated portion of the Work, and in terminating the Contractor's performance, plus a fair and reasonable allowance for overhead and profit thereon (such profit shall not include anticipated profit or consequential damages), provided however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract would have been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss, if any;

(iii) Reasonable costs of settling and paying claims arising out of the termination of subcontracts or orders pursuant to Subparagraph 12.2.1.2 of this Paragraph. These costs shall not include amounts paid in accordance with other provisions hereof.

12.2.1.5 The total sum to be paid the Contractor under this Subparagraph 12.2.1 shall not exceed the total Contract Price, as properly by amounts withheld by the City and reduced by the amount of payments otherwise made, and shall in no event include duplication of payment.

12.2.2 FOR CAUSE

12.2.2.1 The following constitute grounds for termination of this Contract by the City:

(a) the Contractor’s failure or refusal to prosecute the Work in a timely manner;

(b) The Contractor abandons the jobsite and fails to resume work within five (5) days of written notice thereof by the City;

(c) the Contractor fails to meet milestones or comply with approved construction schedules;

(d) the Contractor fails to grant or allow access to the jobsite by the City or Engineer;

(e) the Contractor fails to supply enough properly skilled workers, supervisory personnel or proper equipment or materials;

(f) the Contractor fails to make prompt payment to Subcontractors or for materials or labor;

(g) the Contractor persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction; or,

(h) the Contractor is otherwise guilty of a violation of a material provision of this Contract.

In the event of the occurrence of any one or more of the above events, the City may by written notice to the Contractor, without prejudice to any other right or remedy, terminate the employment of the Contractor, exclude the Contractor from the job site, and take possession of the site and of all materials, equipment, tools, construction

equipment and machinery thereon owned by the Contractor and may finish the Work by whatever methods it may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished.

12.2.2.2 If the unpaid balance of the Contract Price does not exceed the cost of finishing the work, including compensation for the Engineer's additional services and expenses made necessary thereby, such difference shall be paid by the Contractor to the City. This obligation for payment shall survive the termination of the Contract.

12.2.2.3 In the event the employment of the Contractor is terminated by the City for cause pursuant to Subparagraph 12.2.2 and it is subsequently determined by a Court of competent jurisdiction that such termination was without cause, such termination shall thereupon be deemed a Termination for Convenience under Subparagraph 12.2.1 and the provisions of Subparagraph 12.2.1 shall apply.

12.3 USE OF THIRD-PARTY OVERSIGHT OR CONSTRUCTION MANAGER

12.3.1 Should the City allow the Contractor to continue its performance of Work notwithstanding an event of default specified in Subparagraph 12.2.2.1, or should there be an imminent potential of default, the City, at its sole option and within its sole discretion, may retain a third-party construction manager to document the events of default and oversee further progress of the Work. The use of a third-party construction manager shall not prevent the City from declaring the Contractor to be in default and the City may, at its sole option and within its sole discretion, terminate this Contract at any time. Should the City retain a third-party construction manager, the costs thereof shall be withheld from any amounts due Contractor upon termination. The City's exercise of this option shall be without prejudice to any other right or remedy available to the City by law or under this Contract.

ARTICLE XIII

INSURANCE

13.1 CONTRACTOR SHALL MAINTAIN INSURANCE

13.1.1 The Contractor at its own expense shall purchase, maintain and keep in force during the life of this contract, adequate insurance that will protect the Contractor and/or any Additional Insured from claims which may arise out of or result from operations under this Contract. The insurance required shall provide adequate protections from all claims, whether such operations be by the Contractor or by any Additional Insured or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone whose acts of any of them may be liable and from any special hazards, such as blasting, which may be encountered in the performance of this contract in the amounts as shown below in Paragraph 13.2.1.

13.1.2 The Contractor shall not commence work on any Contract in the City until the Contractor has obtained all the insurance required under this paragraph and such insurance has been approved by the City.

13.2 TYPES AND AMOUNTS OF CONTRACTOR'S INSURANCE

13.2.1. The Contractor shall furnish and maintain during the life of the contract adequate Worker's Compensation and Commercial General Liability (Public) Insurance in such amounts as follows:

Type of Insurance	**Amount**
Worker's Compensation	As set forth in the Worker's Compensation Act.
Commercial General Liability (Public)	$1,000,000 Each Accident/Occurrence. $1,000,000 Aggregate $1,000,000 Products &

	Completed Operations Aggregate.
City's Protective Liability Insurance	$600,000 per occurrence $1,000,000 aggregate
Excess/Umbrella Liability	$1,000,000 per occurrence w/drop down coverage
Endorsement CG 2503	Amendment Aggregate Limit of Insurance per Project or City's and Contractor's Protective Liability Insurance for the Project.
Automobile Liability	$500,000 Combined single limit per occurrence.

13.3 ADDITIONAL INSURED

13.3.1 The City and the Engineer shall be named as an additional insured on the Commercial General Liability (Public), City's Protective Liability, and Excess/Umbrella Liability Insurance Policies furnished by the Contractor.

13.4 WRITTEN NOTIFICATION

13.4.1 Each insurance policy shall contain a provision requiring that thirty (30) days prior to expiration, cancellation, non-renewal or any material change in coverage, a notice there of shall be given by certified mail to the City of Lucas, Attention: _____, 665 Country Club Road, Lucas, TX 75002-7561.

13.5 PREMIUMS AND ASSESSMENTS; SUBROGATION

13.5.1 Companies issuing the insurance policies shall have no recourse against the City for payment of any premiums or assessments for any deductibles which are at the sole responsibility and risk of the Contractor. Insurance Companies shall have no right of subrogation against the City or the Engineer.

13.6 CERTIFICATE OF INSURANCE

13.6.1 Proof that the insurance is in force shall be furnished to the City on Standard Certificate of Insurance Forms. In the event any insurance policy shown on the Certificate of Insurance has an expiration date that is prior to the completion and final acceptance of the project by the City, the contractor shall furnish the City proof of identical continued coverage no later than thirty(30) days prior to the expiration date shown on the Certificate of Insurance.

13.7 PRIMARY COVERAGE

13.7.1 The coverages provided herein shall be primary and noncontributory with any other insurance maintained by the City, for its benefit, including self-insurance.

13.8 WORKER'S COMPENSATION INSURANCE COVERAGE

13.8.1 The Contractor shall:

(1) provide coverage for its employees providing services on a project, for the duration of the project based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements;

(2) provide a certificate of coverage showing workers' compensation coverage to the governmental entity prior to beginning work on the project;

(3) provide the governmental entity prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project;

(4) obtain from each person providing services on a project, and provide to the governmental entity:

(A) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(B) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project;

(7) post a notice on each project site informing all persons providing services on the project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage. This notice shall comply with the requirements established by the Division of Workers Compensation of the Texas Department of Insurance, or its successor agency.

and

(8) contractually require each person with whom it contracts to provide services on a project, to:

(A) provide coverage based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements for all of its employees providing services on the project, for the duration of the project;

(B) provide a certificate of coverage to the contractor prior to that person beginning work on the project;

(C) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(D) obtain from each other person with whom it contracts, and provide to the Contractor:

(i) a certificate of coverage, prior to the other person beginning work on the project; and

(ii) prior to the end of the coverage period, a new certificate of coverage showing extension of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(E) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(F) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(G) contractually require each other person with whom it contracts, to perform as required by sub-paragraphs (A) - (G) of this paragraph, with the certificate of coverage to be provided to the person for whom they are providing services.

ARTICLE XIV

MISCELLANEOUS

14.1 LAWS AND ORDINANCES

14.1.1 The Contractor shall at all times and in all respects observe and comply with all federal, state and local laws, ordinances, and regulations applicable to the Project and Work. The Contractor shall further insure that all Subcontractors observe and comply with said laws, ordinances and regulations.

14.2 GOVERNING LAW

14.2.1 The Contract shall be governed by the laws of the State of Texas. Exclusive venue for any causes of action arising under the terms or provisions of this Contract or the Work to be performed hereunder shall be in the state courts of Collin County, Texas.

14.3 SUCCESSORS AND ASSIGNS

14.3.1 The City and Contractor bind themselves, their successors, assigns and legal representatives to the other party hereto and to successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in this Contract. The Contractor shall not assign this Contract without written consent of the City.

14.4 SURETY BONDS

14.4.1 The Contractor shall furnish separate performance and payment bonds to the City, according to the requirements set out in the bid documents and state statutes to guaranty full and faithful performance of the Contract by the Contractor and the full and final payment of all persons supplying labor or materials to the Project. Each bond required by the bid documents or state statute shall set forth a penal sum in an amount not less than the full Contract Price. Each bond furnished by the Contractor shall incorporate by reference the terms of this Contract as fully as though they were set forth verbatim in such bonds. In the event the Contract Price is adjusted by Change Order executed by the Contractor, the penal sum of both the performance bond and the payment bond shall be deemed increased by like amount. The performance and payment bonds furnished by the Contractor shall be in form suitable to the City and shall be executed by a surety, or sureties, reasonably suitable to the City and authorized to do business in the State of Texas.

14.4.2 If the Contract Price exceeds the sum of $25,000.00, the Contractor, upon execution of the Contract and prior to commencement of the Work, shall furnish to the City a two-year maintenance bond in the amount of one hundred percent (100%) of the Contract Price covering the guaranty and maintenance prescribed herein, written by an approved surety authorized and duly licensed to conduct business in the State of Texas. The cost of said maintenance bond shall be included in the Contractor's unit bid prices and shall be paid by the Contractor.

14.5 FORCE MAJEURE

14.5.1 As used herein, "force majeure" means an incident, situation, or act of a third party that is beyond a party's reasonable control such as an act of God, an act of the public enemy, strikes or other labor disturbances (other than strikes within such party's own labor force), hurricanes, earthquakes, fires, floods, epidemics, embargoes, war, and riots. The Contractor will not be liable or responsible for its failure to perform any obligation under this Contract because of an event of Force Majeure, provided, however, that the Contractor submits notice thereof to the City and Engineer within seven (7) days of such an event, obtains a written Change Order, signed by all parties, that allows an extension of the scheduled completion date, and identifies the specific causes and number of days in the Statement of Delay submitted with the next ensuing Application for Payment. Notwithstanding, if the Contractor's failure to perform continues for more than twenty (20) calendar days, the City may at its option terminate this Agreement immediately and pursue such rights and remedies as may be allowed under Subparagraph 12.2.2 of this Contract.

14.6 IMMUNITIES; DEFENSES

14.6.1 Nothing in this Contract shall be deemed to waive any immunity, sovereign, governmental, official, qualified or otherwise, from liability or suit, which the City may have or assert, except as may be provided by law, all such immunities being hereby expressly retained.

14.7 NO RIGHTS IN THIRD PARTIES

14.7.1 The indemnification provisions of this Contract and the rights and remedies afforded herein are solely for the benefit of the parties to this Contract. Nothing in this Contract is intended nor shall be construed to grant, create or confer any right, benefit, interest or cause of action in any person not a party to this Contract, or to the public in general.

14.8 SEVERABILITY

14.8.1 The provisions of this Contract are herein declared to be severable; in the event that any term, provision or part hereof is determined to be invalid, void or unenforceable, such determination shall not affect the validity or enforceability of the remaining terms, provisions and parts, and this Contract shall be read as if the invalid, void or unenforceable portion had not been included herein.

14.9 AMENDMENTS; NO WAIVER

14.9.1 This Contract may be amended by the parties only by a written agreement duly executed by both parties. The failure of the City to object to any nonperformance or nonconforming work or to enforce any provision hereof shall in no event be regarded as or construed to be a waiver, release or modification of any term or provision in this Contract, nor shall such failure to object or enforce estop the City from insisting on strict compliance with this Contract or from recovering damages, costs or expenses arising as a result of such nonperformance or nonconforming work.

14.10 NOTICES

14.10.1 All notices required by this Contract shall be in writing and presumed received when deposited in the mail properly addressed to the other party or Engineer at the address set forth herein or set forth in a written designation of change of address delivered to all parties and the Engineer.

EXECUTED in single or multiple originals, this _____ day of _____, 20___.

CITY OF LUCAS, TEXAS

CONTRACTOR:

_____

Mayor or City Manager

(Signature)

(Type/Print Name and Title)

ATTEST:

(Street Address)

City Secretary (Rev. 03/14)

(City/State/Zip)

APPROVED TO FORM

City Attorney

STATE OF TEXAS §

§ **PERFORMANCE BOND**

COUNTY OF COLLIN §

That _____ of the City of_____,County of _____, State of Texas ("Principal"), and _____ ("Surety"), authorized under the laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto the City of Lucas, Texas ("Owner"), in the penal sum of $____ _____ (*not less than one hundred percent of the approximate total amount of the contract as evidenced in the proposal)* for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the _____ day of _____, 2022, which contract is referred to and made part hereof the same as if fully copied herein.

NOW, THEREFORE, the condition of this obligation is such, that if the said Principal shall fully and faithfully execute the work and perform the contract in accordance with the plans, specifications, and contract documents, including any extensions thereof, and according to the true intent and meaning of said contract and the plans and specifications hereto annexed, then this obligation shall be void; otherwise, to remain in full force and effect.

Provided, however, that this Bond is executed pursuant to the provisions of Section 2253.021 of the Texas Government Code, as amended, for a public work contract, and Section 53.201 of the Property Code, and all liabilities on this Bond shall be determined in accordance with the provisions of said Articles to the same extent as if they were fully copied at length herein.

Surety, for value received, stipulates and agrees that the bond shall automatically be increased by the amount of any change order or supplemental agreement which increases the contract price with or without notice to the Surety and that no change, extension of time, alteration or addition to the terms of the Contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same shall in any way affect its obligation of this Bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder.

Surety agrees that the Bond provides for the repairs and/or replacement of all defects due to faulty materials and workmanship that appear within a period of two years from the date of completion and acceptance of the improvement by the Owner.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument on the

_____ day of _____, 2022.

Principal:	Surety (for all Notices/Claims to be received hereunder):
_____	_____
Title: _____	Title: _____
Company: _____	Company: _____
Address: _____	Address: _____
_____	_____

STATE OF TEXAS §

§ **PAYMENT BOND**

COUNTY OF COLLIN §

That _____ of the City of_____,County of _____, State of Texas ("Principal"), and _____ ("Surety"), authorized under the laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto the City of Lucas, Texas ("Owner"), in the penal sum of $____ _____ (*not less than one hundred percent of the approximate total amount of the contract as evidenced in the proposal)* for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the _____. day of _____, 2022, which contract is referred to and made part hereof the same as if fully copied herein.

NOW, THEREFORE, the condition of this obligation is such, that the bond guarantees the prompt payment and satisfaction of all bills, invoices and statements, including those for usual extras, together with protection of all claims of claimants supplying labor and material and the prosecution of the work provided for in said contract and for the use of each claimant. Should the Principal faithfully perform said contract and in all respects duly and faithfully observe and perform all and singular the covenants, conditions, and agreements in and by said contract agreed to by the Principal, and according to the true intent and meaning of said contract and the claims and specifications hereto annexed, then this obligation shall be void; otherwise, this obligation shall remain in full force and effect.

This Bond is executed pursuant to the provisions of Section 2253.021 of the Texas Government Code, as amended, for a public work contracts, and Section 53.201 of the Property Code, and all liabilities on this Bond shall be subject to and in accordance with the provisions of said Articles to the same extent as if they were fully copied at length herein.

Surety, for value received, stipulates and agrees that the bond shall automatically be increased by the amount of any change order or supplemental agreement which increases the contract price with or without notice to the Surety and that no change, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same shall in any way affect its obligation of this Bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument on the _____ day of _____, 2022.

Principal:	Surety (for all Notices/Claims to be received hereunder):
_____	_____
Title: _____	Title: _____
Company: _____	Company: _____
_____	_____
Address: _____	Address: _____
_____	_____

MAINTENANCE BOND

THE STATE OF TEXAS }

} **KNOW ALL MEN BY THESE PRESENTS:**

COUNTY OF COLLIN }

That _____ of the City of_____,County of _____, State of Texas ("Principal/Contractor"), and _____ ("Surety"), authorized under the laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto the City of Lucas, Texas ("Owner"), in the sum of $_____ (*not less than one hundred percent of the approximate total amount of the contract as evidenced in the proposal)* for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, by these presents:

WHEREAS, the Principal/Contractor has entered into a certain written contract with the Owner, dated the _____ day of _____, 2022, which contract, together with all plans, specifications and requirements therein mentioned, is referred to and made part hereof the same as if fully copied herein.

WHEREAS, under the plans, specifications, and contract, it is provided that the Contractor will maintain and keep in good repair, the work herein contracted to be done and performed, for a period of two (2) years from the date of the acceptance of said work, and to do all necessary repairs and/or reconstructing in whole or in part of said improvements that should be occasioned by defective workmanship or materials furnished in the construction or any part thereof or any of the accessories thereto constructed by the Contractor. It being understood that the purpose of this section is to cover all defective conditions arising by reason of defective material and charge the same against the said Contractor, and sureties on this obligation, and the said Contractor and sureties hereon shall be subject to the liquidation damages mentioned in said contract for each day's failure on its' part to comply with the terms of said provisions of said contract. Now, therefore, if the said Contractor shall keep and perform its' said agreement to maintain said work and keep the same in repair for the said maintenance period of two (2) years, as provided, then these presents shall be null and void, and have not further effect, but if default shall be made by the said Contractor in the performance of its' contract to so maintain and repair said work, then these presents shall have full force and effect, and said **City of Lucas, Texas** shall have and receive from the said Contractor and its' principal and sureties damages in the premises, as provided; and it is further agreed that this obligation shall be a continuing one against the principal and sureties, hereon, and that successive recoveries may be and had hereon for successive branches until the full amount shall have been exhausted; and it is further understood that the obligation herein to maintain said work shall continue throughout said maintenance period, and the same shall not be changed, diminished or in any manner affected from any cause during said time.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument on the _____ day of _____, 2022.

Principal:	**Surety (for all Notices/Claims to be received hereunder):**
By: _____	By: _____
Title: _____	Title: _____
Company: _____	Company: _____
Address: _____	Address: _____
_____	_____

NOTE: Date of Maintenance Bond must not be prior to date of Contract.

CITY OF LUCAS VENDOR REGISTRATION FORM
VENDOR MUST ALSO SUBMIT FORM W9 WITH VENDOR REGISTRATION

Vendor Number:_____ Entry Date:_____
(to be completed by Lucas)

Bidder/Vendor Application

Complete this application and email it to agibson@lucastexas.us and sholden@lucastexas.us.

Company Name: _____ Tel: ( ) _____

Mailing Address: _____ City: _____ State: _____ Zip: _____

Email: _____ Fax: _____ Tax I.D. NO: _____

Remit to Address: _____ City: _____ State: _____ Zip: _____

Do you accept a **Credit Card** for payment? Yes _____ No_____ **EFT?** Yes _____ No_____

Representative(s) Name & Title_____

Type of Organization (check one) Individual: _____ Partnership: _____ Corporation: _____

State of Incorporation: _____ Other_____

Type of Business (check one) Manufacturer: _____ Wholesaler: _____ Retailer: _____Broker: _____

Distributor: _____ Service Organization: _____ Other_____

Name & Title of Person(s) Authorized to Sign Bids , and/or Contracts: _____

Small and/or Disadvantaged Business Information (check applicable criteria)

Small Business:

_____ Less than 50

_____ 51-99 employees

_____ Less than $1 million annual gross receipts

_____ $1-3 million annual gross receipts

Disadvantaged Business (At Least 51% Ownership)

_____ Black American

_____ Hispanic American

_____ Asian Pacific American

_____ Native American

_____ Women

☐ I am a currently employed by the City of Lucas
☐ I have previously been employed by the City of Lucas Employment date:_____
☐ I am related to an employee of the City of Lucas Employee name: _____

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: _____ Date: _____

Print Name & Title of Signatory:_____

CERTIFICATE OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.

4 Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5

☐ **Check only if there is NO Interested Party.**

6 UNSWORN DECLARATION

My name is _____, and my date of birth is _____.

My address is _____, _____, _____, _____, _____.
(street) (city) (state) (zip code) (country)

I declare under penalty of perjury that the foregoing is true and correct.

Executed in _____ County, State of _____, on the _____ day of _____, 20_____.
(month) (year)

_____
Signature of authorized agent of contracting business entity (Declarant)

ADD ADDITIONAL PAGES AS NECESSARY

Must file online at www.ethics.state.tx.us/File

Implementation of House Bill 1295

Certificate of Interested Parties (Form 1295):

In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Government Code. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency.

The law applies (with a few exceptions) only to a contract between a business entity and a governmental entity or state agency that either (1) requires an action or vote by the governing body of the entity or agency before the contract may be signed or (2) has a value of at least $1 million. The disclosure requirement applies to a contract entered into on or after January 1, 2016.

Changed or Amended Contracts:

Form 1295 is only required for a change made to an existing contract in certain circumstances: (1) if a Form 1295 was not filed for the existing contract, then a filing is only required if the changed contract either requires an action or vote by the governing body or the value of the changed contract is at least $1 million; or (2) if a Form 1295 was filed for the existing contract, then another filing is only required for the changed contract if there is a change to the information disclosed in the Form 1295, the changed contract requires an action or vote by the governing body, or the value of the changed contract increases by at least $1 million.

As required by law, the Commission adopted the Certificate of Interested Parties form (Form 1295) on October 5, 2015. The Commission also adopted rules (Chapter 46) to implement the law. The Commission does not have any additional authority to enforce or interpret section 2252.908 of the Government Code.

Filing Process:

A business entity must use the Form 1295 filing application the Commission created to enter the required information on Form 1295 and print a copy of the completed form. Once entered into the filing application, the completed form will include a unique certification number, called a “certification of filing.”

An authorized agent of the business entity must sign the printed copy of the form affirming under the penalty of perjury that the completed form is true and correct.

The completed, printed, and signed Form 1295 bearing the unique certification of filing number must be filed with the governmental body or state agency with which the business entity is entering into the contract.

Acknowledgement by State Agency or Governmental Entity:

The governmental entity or state agency must acknowledge receipt of the filed Form 1295 with the certification of filing, using the Commission’s filing application, not later than the 30th day after the date the governing body or state agency receives the Form 1295. The Commission will post the completed Form 1295 to its website within seven business days after the governmental entity or state agency acknowledges receipt of the form.

Additional Information:

80

Section 2252.908, Government Code.

Certificate of Interested Parties (Form 1295)**
This is a sample form for illustration purposes only. DO NOT FILL OUT THIS SAMPLE FORM. Form 1295 MUST BE FILED ELECTRONICALLY! Paper copies and PDF copies of this sample form are not accepted!

Chapter 46, Ethics Commission Rules (includes new rule 46.4, regarding changes to contracts, which went into effect on January 1, 2017)

Frequently Asked Questions

Last Revision: December 21, 2017

81

CITY OF LUCAS
CONTRACTOR INSURANCE REQUIREMENTS & AGREEMENT

(a) Vendor on City property or public right-of-way for the City of Lucas shall provide the City a certificate of insurance evidencing the coverage's and coverage provisions identified herein. Contractors shall provide the City evidence that all subcontractors performing work on the project have the same types and amounts of coverage's as required herein or that the subcontractors are included under the contractor's policy.

(b) All insurance and certificate(s) of insurance shall contain the following provisions: (1) name the City, its officers, agents and employees as additional insureds as to all applicable coverage with the exception of Workers Compensation Insurance; (2) provide for at least thirty (30) days prior written notice to the City for cancellation, non-renewal, or material change of the insurance; (3) provide for a waiver of subrogation against the City for injuries, including death, property damage, or any other loss to the extent the same is covered by the proceeds of insurance.

(c) All insurance companies providing the required insurance shall be authorized to transact business in Texas and rated at least "A" by AM Best or other equivalent rating service.

User shall during the term hereof maintain in full force and affect the following insurance: The City reserves the right to amend or require addition all types depending on the nature of the work.

Contracts in the Amount of $0-$100,000

Type of Insurance	Amount of Insurance	Provisions
1. Commercial General (Public) Liability to include coverage for: a) Premises/Operations b) Products/Completed Operations c) Independent Contractors d) Personal Liability e) Contractual Liability	$500,000 each occurrence, $1,000,000 general aggregate; or $1,000,000 combined single limits	City to be listed as additional insured and provided 30-day notice of cancellation or material change in coverage. City prefers that insurer be rated A or higher by A.M. Best or equivalent. Waiver of Subrogation to apply
2. Business Auto Liability	$500,000 combined single limit	Owned, non-owned, and hired vehicles
3. Workers' Comp & Employers' Liability	Statutory Limits $1,000,000 each accident	Waiver of subrogation
4. a) Professional Liability b) E & O coverage	1,000,000 per occurrence	If Applicable

Contracts in the Amount of $100,000-$1,000,000

Type of Insurance	Amount of Insurance	Provisions
1. Commercial General (Public) Liability to include coverage for: f) Premises/Operations g) Products/Completed Operations h) Independent Contractors i) Personal Liability j) Contractual Liability	$1,000,000 each occurrence $2,000,000 general aggregate $2,000,000 Umbrella/ Excess Liability	City to be listed as additional insured and provided 30-day notice of cancellation or material change in coverage. City requires that insurer be rated A or higher by A.M. Best or equivalent. Waiver of subrogation
2. Business Auto Liability	• $1,000,000 per occurrence • $1,000,000 aggregate or; • $1,000,000 combined single limits	City to be named as a additional insured
3. Workers' Comp & Employers' Liability	Statutory Limits $1,000,000 each accident	Waiver of subrogation
4. Builders Risk Policy	100% of construction total	If Applicable
5.a) Professional Liability b) E & O coverage	1,000,000 per occurrence	If Applicable

Contracts in the Amount of $1,000,000-$8,000,000

Type of Insurance	**Amount of Insurance**	**Provisions**
1. Broad Form Commercial General Liability to include coverage for: k) Premises/Operations l) Products/Completed Operations m) Independent Contractors n) Personal Liability o) Contractual Liability	$2,000,000 each occurrence, $4,000,000 general aggregate; $4,000,000 umbrella	City to be listed as additional insured and provided 30-day notice of cancellation or material change in coverage. City requires that insurer be rated A or higher by A.M. Best or equivalent. Waiver of Subrogation
2. Business Auto Liability	• $1,000,000 per occurrence • $2,000,000 aggregate or; • $2,000,000 combined single limits	City to be named as additional insured
3. Workers' Comp & Employers' Liability	Statutory Limits $1,000,000 each accident	City to be provided a waiver of subrogation
4. Builders Risk Policy	100% of construction total	If Applicable
5. a) Professional Liability b) E & O coverage	1,000,000 per occurrence	If Applicable

All Contracts over $8,000,000 must contact Risk Management for insurance specifications

All Certificates of Insurance need to reference job or contract number in comments section.

Questions regarding insurance should be directed to the City of Lucas Purchasing Division (214)509-4630 or the City of Lucas Risk Administrator at (214) 509-4685. This form must be signed and returned with your quotation to verify that you can and will meet the insurance requirements listed herein should you be selected to perform work for the City, and will provide the certificates of insurance acceptable to the City.

Indemnification.

COMPANY DOES HEREBY COVENANT AND CONTRACT TO WAIVE ANY AND ALL CLAIMS, RELEASE, INDEMNIFY, AND HOLD HARMLESS THE CITY, ITS CITY COUNCIL, OFFICERS, EMPLOYEES, AND AGENTS, FROM AND AGAINST ALL LIABILITY, CAUSES OF ACTION, CITATIONS, CLAIMS, COSTS, DAMAGES, DEMANDS, EXPENSES, FINES, JUDGMENTS, LOSSES, PENALTIES OR SUITS, CAUSED BY OR RESULTING FROM THE NEGLIGENCE, INTENTIONAL TORT, INTELLECTURAL PROPERTY INFRINGEMENT, OR FAILURE TO PAY A SUBCONTRACTOR OR SUPPLIER COMMITTED BY THE COMPANY, ITS AGENT, ITS CONSULTANT UNDER CONTRACT, OR ANY OTHER ENTITY OVER WHICH THE COMPANY EXERCISES CONTROL SUBJECT TO THE LIMITATIONS IN TEXAS LOCAL GOVERNMENT CODE § 271.904 AND TEXAS CIVIL PRACTICE AND REMEDIES CODE, § 130.002 (B).

INDEMNIFIED ITEMS SHALL INCLUDE REASONABLE ATTORNEYS' FEES AND COSTS, COURT COSTS, AND SETTLEMENT COSTS IN PROPORTION TO THE PROFESSIONAL'S LIABILITY.

THE COMPANY'S OBLIGATIONS UNDER THIS SECTION SHALL NOT BE LIMITED TO THE LIMITS OF COVERAGE OF INSURANCE MAINTAINED OR REQUIRED TO BE MAINTAINED BY COMPANY UNDER THIS AGREEMENT. THIS PROVISION SHALL SURVIVE THE TERMINATION OF THIS AGREEMENT.

City of Lucas Project or Bid Number:_____

PURCHASE ORDER WILL NOT BE ISSUED WITHOUT EVIDENCE OF INSURANCE

WORKERS COMPENSATION INSURANCE COVERAGE DEFINITIONS

A. Definitions:

Certificate of coverage ("certificate") – A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entities' employees providing services on a project, for the duration of the project.

Duration of the project – includes the time from the beginning of the work on the project until the contractor's/person's work on the project had been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in § 406.096) – includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity witch furnishes person to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

B. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meet the statutory requirements of Texas Labor Code, Section 401.011 (44) for all employees of the contractor providing services on the project, for the duration of the project.

C. The contractor must provide a certificate of coverage to the governmental entity with bid submittal.

D. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the overage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

(1) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and
(2) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

F. The contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

G. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

H. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers Compensation Commission, informing all person providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

I. The contractor shall contractually require each person with whom it contracts to provide services on a project to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all its employees providing service on the project, for the duration of the project;

(2) provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing the services on the project, for the duration of the project;

(3) provide the contractor, prior to the end of the coverage period, an new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) obtain from each other person with whom it contracts, and provide to the contractor;

(A). a certificate of coverage, prior to the other person beginning work on the project; and

(B). a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) – (7), with the certificates of coverage to be provided to the person for whom they are providing services.

J. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or , in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal, penalties, civil penalties, or other civil actions.

K. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the governmental entity.

INSURANCE BINDER

DATE (MM/DD/YYYY)

THIS BINDER IS A TEMPORARY INSURANCE CONTRACT, SUBJECT TO THE CONDITIONS SHOWN ON THE REVERSE SIDE OF THIS FORM.

AGENCY	COMPANY	BINDER #

EFFECTIVE DATE	EFFECTIVE TIME		EXPIRATION DATE	EXPIRATION TIME	
		☐ AM ☐ PM		☐ 12:01 AM ☐ NOON	

PHONE (A/C, No, Ext):	FAX (A/C, No):
CODE:	SUB CODE:
AGENCY CUSTOMER ID:	

☐ THIS BINDER IS ISSUED TO EXTEND COVERAGE IN THE ABOVE NAMED COMPANY PER EXPIRING POLICY #:

INSURED

DESCRIPTION OF OPERATIONS/VEHICLES/PROPERTY (Including Location)

COVERAGES

LIMITS

TYPE OF INSURANCE	COVERAGE/FORMS	DEDUCTIBLE	COINS %	AMOUNT
PROPERTY CAUSES OF LOSS ☐ BASIC ☐ BROAD ☐ SPEC				
GENERAL LIABILITY ☐ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS MADE ☐ OCCUR	RETRO DATE FOR CLAIMS MADE:	EACH OCCURRENCE		$
		DAMAGE TO RENTED PREMISES		$
		MED EXP (Any one person)		$
		PERSONAL & ADV INJURY		$
		GENERAL AGGREGATE		$
		PRODUCTS - COMP/OP AGG		$
VEHICLE LIABILITY ☐ ANY AUTO ☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS ☐ HIRED AUTOS ☐ NON-OWNED AUTOS	SAMPLE	COMBINED SINGLE LIMIT		$
		BODILY INJURY (Per person)		$
		BODILY INJURY (Per accident)		$
		PROPERTY DAMAGE		$
		MEDICAL PAYMENTS		$
		PERSONAL INJURY PROT		$
		UNINSURED MOTORIST		$
				$
VEHICLE PHYSICAL DAMAGE DED ☐ COLLISION: ☐ OTHER THAN COL:	☐ ALL VEHICLES ☐ SCHEDULED VEHICLES	☐ ACTUAL CASH VALUE ☐ STATED AMOUNT		$
GARAGE LIABILITY ☐ ANY AUTO		AUTO ONLY - EA ACCIDENT		$
		OTHER THAN AUTO ONLY:		
		EACH ACCIDENT		$
		AGGREGATE		$
EXCESS LIABILITY ☐ UMBRELLA FORM ☐ OTHER THAN UMBRELLA FORM	RETRO DATE FOR CLAIMS MADE:	EACH OCCURRENCE		$
		AGGREGATE		$
		SELF-INSURED RETENTION		$
WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY		☐ WC STATUTORY LIMITS		
		E.L. EACH ACCIDENT		$
		E.L. DISEASE - EA EMPLOYEE		$
		E.L. DISEASE - POLICY LIMIT		$
SPECIAL CONDITIONS / OTHER COVERAGES		FEES		$
		TAXES		$
		ESTIMATED TOTAL PREMIUM		$

NAME & ADDRESS

	☐ MORTGAGEE ☐ ADDITIONAL INSURED ☐ LOSS PAYEE
	LOAN #
	AUTHORIZED REPRESENTATIVE

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AGENCY CUSTOMER ID: _____

CONDITIONS

This Company binds the kind(s) of insurance stipulated on the reverse side. The Insurance is subject to the terms, conditions and limitations of the policy(ies) in current use by the Company.

This binder may be cancelled by the Insured by surrender of this binder or by written notice to the Company stating when cancellation will be effective. This binder may be cancelled by the Company by notice to the Insured in accordance with the policy conditions. This binder is cancelled when replaced by a policy. If this binder is not replaced by a policy, the Company is entitled to charge a premium for the binder according to the Rules and Rates in use by the Company.

Applicable in California

When this form is used to provide insurance in the amount of one million dollars ($1,000,000) or more, the title of the form is changed from "Insurance Binder" to "Cover Note".

Applicable in Colorado

With respect to binders issued to renters of residential premises, home owners, condo unit owners and mobile home owners, the insurer has thirty (30) business days, commencing from the effective date of coverage, to evaluate the issuance of the insurance policy.

Applicable in Delaware

The mortgagee or Obligee of any mortgage or other instrument given for the purpose of creating a lien on real property shall accept as evidence of insurance a written binder issued by an authorized insurer or its agent if the binder includes or is accompanied by: the name and address of the borrower; the name and address of the lender as loss payee; a description of the insured real property; a provision that the binder may not be canceled within the term of the binder unless the lender and the insured borrower receive written notice of the cancellation at least ten (10) days prior to the cancellation; except in the case of a renewal of a policy subsequent to the closing of the loan, a paid receipt of the full amount of the applicable premium, and the amount of insurance coverage.

Chapter 21 Title 25 Paragraph 2119

Applicable in Florida

Except for Auto Insurance coverage, no notice of cancellation or nonrenewal of a binder is required unless the duration of the binder exceeds 60 days. For auto insurance, the insurer must give 5 days prior notice, unless the binder is replaced by a policy or another binder in the same company.

Applicable in Maryland

The insurer has 45 business days, commencing from the effective date of coverage to confirm eligibility for coverage under the insurance policy.

Applicable in Michigan

The policy may be cancelled at any time at the request of the insured.

Applicable in Nevada

Any person who refuses to accept a binder which provides coverage of less than $1,000,000.00 when proof is required: (A) Shall be fined not more than $500.00, and (B) is liable to the party presenting the binder as proof of insurance for actual damages sustained therefrom.

Applicable in the Virgin Islands

This binder is effective for only ninety (90) days. Within thirty (30) days of receipt of this binder, you should request an insurance policy or certificate (if applicable) from your agent and/or insurance company.

CONTRACTOR'S AFFIDAVIT OF BILLS PAID

STATE OF TEXAS

COUNTY OF COLLIN

Personally, before me the undersigned authority, on this day appeared _____ who, being duly sworn, on oath, says that he is a legal representative of _____
(full name of Contractor as in contract)

and that Work Order No._____ for the contract designated as

WEST LUCAS ROAD RECONSTRUCTION AND WIDENING

(BID NO. XXX-XX)

has been satisfactorily completed and that all bills for materials, apparatus, fixtures, machinery and labor used in connection with the construction of this Work Order have, to the best of my knowledge and belief, been fully paid.

_____
(Signature)

_____
Title

Sworn to and subscribed before me this _____day of _____, 2022.

_____
Notary Public in and for

_____ County, Texas

Instructions:

If the contractor is an individual, he shall sign the affidavit. If the contractor is a partnership, any partner may sign the affidavit. If the contractor is a corporation, a person authorized by the by-laws or by the Board of Directors shall sign the affidavit. If the Contractor is a joint-venture of individuals, any of the individuals may sign the affidavit. If the Contractor is a joint-venture of partnerships, or of individuals and partnerships, the affidavit may be signed by the individual or any partner of any partnership. If the contractor is a joint-venture in which a corporation is a party, separate affidavit must be executed in the name of the joint-venture: one by each corporation and one by each individual or partnership. Signatures for corporations should be by a duly authorized officer. If signature is by another, a showing of authority to sign must accompany the affidavit.

CITY OF LUCAS, TEXAS

SAMPLE

PUBLIC WORKS CONSTRUCTION PROJECT

West Lucas Road

Reconstruction

and Widening,

Bid #,

Vendor name

TABLE OF CONTENTS

ARTICLE I; THE CONTRACT AND THE CONTRACT DOCUMENTS 1
1.1 The Contract 1
1.2. The Contract Documents 1
1.3 Entire Agreement 1
1.4 No Privity with Others 1
1.5 Intent and Interpretation 1
1.6 Ownership of Contract Documents 2

ARTICLE II; THE WORK 2
2.1 The Work 2
2.2 Work 3

ARTICLE III; CONTRACT TIME 3
3.1 Substantial Completion 3
3.2 Time 3
3.3 Time is of the Essence 4
3.4 Liquidated Damages 4
3.5 No Damages for Delay; No Back-Charges; Damage Waiver 4

ARTICLE IV; CONTRACT PRICE 5
4.1 The Contract Price 5

ARTICLE V; PAYMENT OF THE CONTRACT PRICE 5
5.1 Schedule of Values 5
5.2 Payment Procedure 5
5.3 Withheld Payment 6
5.4 Unexcused Failure to Pay 6
5.5 Certificate of Substantial Completion 7
5.6 Completion and Final Payment 7

ARTICLE VI; THE CITY 8
6.1 Information, Services and Things Required from City 8
6.2 Right to Stop Work 8
6.3 City's Right to Perform Work 8

ARTICLE VII; THE CONTRACTOR 8
7.1 Must Follow Contract 8
7.2 Use of Web-Based Project Management System 8
7.3 Prosecution of Work 8
7.4 Warranty 9
7.5 Permits; Fees; Licenses 9
7.6 Supervision 9
7.7 Work Schedule 9
7.8 On-Site Drawings 10
7.9 As-Built Plans, Shop Drawings, Product Data, and Samples 10
7.10 Cleaning the Site and the Project 10
7.11 Access to Work and Inspections 10
7.12 Indemnity and Disclaimer 10
7.13 Nondiscrimination 11
7.14 Prevailing Wage Rates 11
7.15 Job Site Safety Precautions 11
7.16 Warning Devices and Barricades 12
7.17 Protection of Utilities and Other Contractors 12

SAMPLE

ARTICLE VIII; CONTRACT ADMINISTRATION 12
8.1 The Engineer 12
8.2 Engineer's Administration 12
8.3 Claims by the Contractor 13
8.4 Extra Work 13
8.5 Claims for Additional Costs or Time; Contract Price Increase 14
8.6 Field Orders 14
8.7 Mediation 14

ARTICLE IX; SUBCONTRACTORS 15
9.1 Definition 15
9.2 Award of Subcontracts 15

ARTICLE X; CHANGES IN THE WORK 15
10.1 Changes Permitted 15
10.2 Change Order Defined 15
10.3 Changes in the Contract Price 15
10.4 Minor Changes 16
10.5 Effect of Executed Change Order 16
10.6 Notice to Surety; Consent 16

ARTICLE XI; UNCOVERING AND CORRECTING WORK 16
11.1 Uncovering Work 16
11.2 Correcting Work 16
11.3 City May Accept Defective or Nonconforming Work 17

ARTICLE XII; CONTRACT DEFAULT AND TERMINATION 17
12.1 Termination by the Contractor 17
12.2 Termination by the City 17
12.3 Use of Third-Party Oversight or Construction Manager 19

ARTICLE XIII; INSURANCE 19
13.1 Contractor Shall Maintain Insurance 19
13.2 Types and Amounts of Contractor's Insurance 19
13.3 Additional Insured 19
13.4 Written Notification 19
13.5 Premiums and Assessments; Subrogation 20
13.6 Certificate of Insurance 20
13.7 Primary Coverage 20
13.8 Worker's Compensation Insurance Coverage 20

ARTICLE XIV; MISCELLANEOUS 21
14.1 Laws and Ordinances 21
14.2 Governing Law 21
14.3 Successors and Assigns 21
14.4 Surety Bonds 21
14.5 Force Majeure 22
14.6 Immunities; Defenses 22
14.7 No Rights in Third Parties 22
14.8 Severability 22
14.9 Amendments; No Waiver 22
14.10 Notices 22

SAMPLE

City of Lucas, Texas

This Agreement is made by and between the City of Lucas, Texas, a home-rule municipality (hereinafter referred to as the "City") and ***[ENTER CONTRACTOR LEGAL NAME]***, (hereinafter referred to as the "Contractor") for construction of ***West Lucas Road Reconstruction and Widening***, (hereinafter referred to as the "Project"), the City and the Contractor hereby agreeing as follows:

ARTICLE I

THE CONTRACT AND THE CONTRACT DOCUMENTS

1.1 THE CONTRACT

1.1.1 The contract between the City and the Contractor, of which this agreement (sometimes referred to herein as the "Contract") is a part, consists of the Contract Documents. It shall be effective on the date this Agreement is executed by the last party to execute it.

1.2. THE CONTRACT DOCUMENTS

1.2.1 The Contract Documents consist of this agreement, the General Conditions, the Special Conditions, the Invitation to Bid, Requirements and Instructions to Bidders, the Specifications, the Drawings, the Shop Drawings, the Project Manual, all Change Orders and Field Orders issued hereafter, the addenda, exhibits and attachments thereto, any other amendments hereto executed by the parties hereafter, together with the following (if any):

1.3 ENTIRE AGREEMENT

1.3.1 This Contract, together with the Contractor's performance and payment bonds for the Project, all General Conditions, Special Conditions, Plans and Specifications, and Addenda attached thereto, constitute the entire and exclusive agreement between the City and the Contractor with reference to the Project. Specifically, but without limitation, this Contract supersedes any bid documents and all prior written or oral communications, representations and negotiations, if any, between the City and Contractor not expressly made a part hereof.

1.4 NO PRIVITY WITH OTHERS

1.4.1 Nothing contained in this Contract shall create, or be interpreted to create, privity or any other contractual agreement between the City and any person or entity other than the Contractor.

1.5 INTENT AND INTERPRETATION

1.5.1 The intent of this Contract is to require complete, correct and timely execution of the Work. Any Work that may be required, implied or inferred by the Contract Documents, or any one or more of them, as necessary to produce the intended result shall be provided by the Contractor for the Contract Price.

1.5.2 This Contract is intended to be an integral whole and shall be interpreted as internally consistent. What is required by any one Contract Document shall be considered as required by the Contract.

1.5.3 When a word, term or phrase is used in this Contract, it shall be interpreted or construed, first, as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage.

SAMPLE

1.5.4 The word “City” includes the City of Lucas, Texas, a municipal corporation, and its public officials, officers, employees, agents and employees. The word “Contractor” includes the Contractor and its officers, employees, agents and representatives. The word "include", "includes", or "including", as used in this subparagraph and in this Contract, shall be deemed to be followed by the phrase, "without limitation".

1.5.5 The specification herein of any act, failure, refusal, omission, event, occurrence or condition as constituting a material breach of this Contract shall not imply that any other, non-specified act, failure, refusal, omission, event, occurrence or condition shall be deemed not to constitute a material breach of this Contract.

1.5.6 Words or terms used as nouns in this Contract shall be inclusive of their singular and plural forms, unless the context of their usage clearly requires a contrary meaning.

1.5.7 The Contractor shall have a continuing duty to read, carefully study and compare each of the Contract Documents, the Shop Drawings, the Product Data, and any Plans and Specifications, and shall give written notice to the City of any inconsistency, ambiguity, error or omission which the Contractor may discover with respect to these documents before proceeding with the affected Work. The issuance, or the express or implied approval by the City or the Engineer of the Contract Documents, Shop Drawings or Product Data, shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with this Contract. The City has requested the Engineer to only prepare documents for the Project, including the Drawings, Plans and Specifications for the Project, which are accurate, adequate, consistent, coordinated and sufficient for construction. HOWEVER, THE CITY MAKES NO REPRESENTATION OR WARRANTY OF ANY NATURE WHATSOEVER TO THE CONTRACTOR CONCERNING SUCH DOCUMENTS. THE CONTRACTOR ASSUMES ALL RISK OF ERRORS, AMBIGUITIES AND INACCURACIES. By the execution hereof, the Contractor acknowledges and represents that it has received, reviewed and carefully examined such documents, has found them to be complete, accurate, adequate, consistent, coordinated and sufficient for construction, and that the Contractor has not, does not, and will not rely upon any representation or warranties by the City concerning such documents as no such representation or warranties have been or are hereby made. Further, the Contractor represents and warrants that it has had a sufficient opportunity to inspect the Project site and assumes any and all responsibility for inadequacies or ambiguities in the plans, drawings or specifications as well as for latent conditions of the site where the work is to be performed.

1.5.8 As between numbers and scaled measurements on the Drawings and in the Design, the numbers shall govern, as between larger scale and smaller scale drawings, the larger scale shall govern.

1.5.9 Neither the organization of any of the Contract Documents into divisions, sections, paragraphs, articles, (or other categories), nor the organization or arrangement of the Design, shall control the Contractor in dividing the Work or in establishing the extent or scope of the Work to be performed by Subcontractors.

1.6 OWNERSHIP OF CONTRACT DOCUMENTS

1.6.1 The Contract Documents, and each of them individually and collectively, shall remain the property of the City. The Contractor shall have the right to keep one record set of the Contract Documents upon completion of the Project; provided, however, that in no event shall Contractor use, or permit to be used, any or all of such Contract Documents on other projects without the City's prior written authorization.

ARTICLE II

THE WORK

2.1 The Contractor shall perform all of the Work required, implied or reasonably inferable from this Contract.

SAMPLE

2.2 WORK

2.2.1 The term "Work" shall mean whatever is done by or required of the Contractor to perform and complete its duties under this Contract, including the following: construction of the whole or a designated part of the Project; furnishing of any required surety bonds and insurance, and the provision or furnishing of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, permits and licenses required of the Contractor, power, water, fuel, heat, light, cooling and all other utilities as required by this Contract. The Work to be performed by the Contractor is generally described as follows:

The construction and roadway improvements of West Lucas Road consist of: Paving, Drainage, Traffic Control, Utilities, Signing and Pavement Markings, Replacement of Existing Culverts.

2.2.2 The Contractor shall be responsible for paying for and procuring all materials and labor and furnishing all services necessary or appropriate for the full performance of the Work and the for the full completion of the Project. All materials shall be new and materials and workmanship shall be of good quality. Upon request, the Contractor shall furnish satisfactory proof of the type, kind, and quality of materials.

ARTICLE III

CONTRACT TIME

SAMPLE

3.1 SUBSTANTIAL COMPLETION

3.1.1 "Substantial Completion" shall mean that stage in the progression of the Work when the Work is sufficiently complete in accordance with this Contract that the City can enjoy beneficial use or occupancy of the Work and can utilize the Work for its intended purpose, even though minor miscellaneous work and/or adjustment may be required.

3.2 TIME

3.2.1 The Contractor shall commence the Work within 10 days of receipt of a written Notice to Proceed, and shall achieve Substantial Completion of the Work no later than **/___/** calendar days from the date specified in the Notice to Proceed. The term “calendar days” shall mean any and all days of the week or month, no days being excepted. The number of calendar days from the date on which the Work is permitted to proceed, through the date set forth for Substantial Completion, shall constitute the Contract Time” and the “scheduled completion date.” The execution of this Contract by the Contractor constitutes an agreement that adequate time has been allotted for this Contract, given the Contract Price.

3.2.2 Work may proceed on any day of the week, including weekends, and at any time of the day. However, work shall not occur on such days or at such times as, in the City’s or Engineer’s discretion, may be a violation of noise or environmental regulations or ordinances, or when the presence of workers, equipment or materials may create an abnormally hazardous condition.

3.2.3 The Contractor shall submit and comply with construction schedules establishing completion timelines and deadlines for each component of the Project. Construction schedules shall be submitted to and approved by the Engineer and the City on a regular basis as required by the Contract Documents. If no reference is made to construction schedules in the Contract Documents, then construction schedules shall be submitted with each Application for Payment.

3.3 TIME IS OF THE ESSENCE

3.3.1 The scheduled completion date is based on public necessity. The scheduled completion date is factored into and is a material component of the Contract Price. All limitations of time set forth in the Contract Documents are of the essence of this Contract.

3.3.2 TIME IS OF THE ESSENCE IN THE PERFORMANCE OF THE WORK AND THE COMPLETION OF THE PROJECT ON OR BEFORE THE SCHEDULED COMPLETION DATE. THE SCHEDULED COMPLETION DATE IS A DEADLINE. THE CITY EMPLOYS A ZERO-TOLERANCE POLICY REGARDING THE TIME FOR COMPLETION. The time for completion is an essential and material term of this Contract and the Contractor's failure to achieve substantial completion on the date stated herein, to comply with work schedules, or achieve milestones in approved construction schedules, shall be a material breach and default of this Contract.

3.3.3 The City will assess liquidated damages for late or untimely performance and may, at the City's sole option, elect to allow Contractor to continue with the Work, or may declare Contractor to be in breach and default of the Contract and order Contractor to remove all equipment and personnel from the work site. All remedies for Contractor's late performance shall be nonexclusive and cumulative without waiver of any other, and the City's election of one shall not preclude the City from pursuing any other.

3.3.4 It is contemplated by the parties that the progress of the Work may be delayed by certain conditions beyond the control of the parties; these delays have been contemplated by the parties and considered in the time allotted for performance specified herein and in the contract price and includes, but is not limited to delays occasioned on account of adverse weather, temporary unavailability of materials, shipment delays, and the presence and potential interference of other contractors or of utilities that may be performing work at the Project site unrelated to this Contract. These delays have been considered and included in the determination of the scheduled completion date and the Contract Price.

SAMPLE

3.4 LIQUIDATED DAMAGES;

3.4.1 The Contractor shall pay the City the sum of $_____ per day for each and every calendar day of unexcused delay in achieving Substantial Completion beyond the date set forth herein for Substantial Completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by the City, estimated at or before the time of executing this Contract. When the City reasonably believes that Substantial Completion will be inexcusably delayed, the City shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the City to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the City has withheld payment, the City shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. If the Contractor has submitted a Statement of Delay with the appropriate Application for Payment as required by Subparagraph 5.2.3, and/or has complied with the notice and Change Order requirements of this Contract, the Engineer shall have sole discretion to determine whether a delay is excused or unexcused and the Engineer's determination thereof shall be final and binding on the parties.

3.5 NO DAMAGES FOR DELAY; NO BACK-CHARGES; DAMAGE WAIVER

3.5.1 No claim shall be made by the Contractor to the City, and no damages, costs or extra compensation shall be allowed or paid by the City to the Contractor for any delay or hindrance from any cause in the progress or completion of the Work or this Contract. The Contractor's sole remedy in the event of any delay or hindrance, regardless of cause, shall be to request time extensions by written change orders as provided for hereinafter. The failure to seek or obtain a change order for time extension shall be deemed a waiver thereof and Contractor shall be regarded as having made a determination that the delay will not affect the completion of the Work. Should the Contractor be delayed by an act of the City, or should the City order a stoppage of the Work for sufficient cause unrelated to any act or omission of the Contractor, an extension of time shall be granted by the City by Change Order upon written application, which extension shall not be unreasonably denied, to compensate for the delay.

3.5.2 The City shall have the authority to suspend the Work wholly or in part for such period or periods of time as it may deem appropriate due to unsuitable conditions considered unfavorable for the proper prosecution of the Work or for the failure of the Contractor to carry out instructions from the City or City's representative. During any period in which the Work is stopped or during which any of the Work is not actively in progress for any reason,

Contractor shall properly protect the site and the Work from damage, loss or harm. The Contractor shall not be compensated for periods of delay caused by a suspension of the work by the City. If work is suspended due to unsuitable conditions through no fault of the Contractor, an extension of time shall be granted by the City by Change Order upon written application, which extension shall not be unreasonably denied, to compensate for the delay.

3.5.3 The Contractor shall not have or assert any claim against the City for damages or back-charges of any kind for any reason, including but not limited to claims for Extra Work, damages, economic loss, additional costs, unknown latent site conditions, and refusals by the City to grant extensions of time, unless supported and authorized by a written Change Order or separate agreement signed by all parties. The Contractor, in entering into this Contract, hereby waives, releases, quitclaims, discharges and holds harmless the City from and against any and all claims, damages, liabilities and losses, save and except those arising under Paragraph 12.1 of this Contract.

ARTICLE IV

CONTRACT PRICE

4.1 THE CONTRACT PRICE

4.1.1 The City shall pay, and the Contractor shall accept, as full and complete payment for all of the Work required herein, the fixed sum of

$/_____/.

The sum set forth in this Paragraph 4.1 shall constitute the Contract Price which shall not be modified except by written Change Order as provided in this Contract, or the assessment of liquidated damages or the award of an early completion bonus.

SAMPLE

ARTICLE V

PAYMENT OF THE CONTRACT PRICE

5.1 SCHEDULE OF VALUES

5.1.1 The Schedule of Values, submitted to and accepted by the City and Engineer at the time of the Contractor's bid, allocates the Contract Price to the various portions of the Work. The Contractor's Schedule of Values shall have been be prepared, or at the City's or Engineer's request shall be amended prior to the commencement of construction, in such form, with such detail, and supported by such data as the Engineer or the City may require to substantiate its accuracy. The Contractor shall not imbalance its Schedule of Values nor artificially inflate any element thereof. The violation of this provision by the Contractor shall constitute a material breach of this Contract.

The Schedule of Values shall be used only as a basis for the Contractor's Applications for Payment and shall only constitute such basis after it has been acknowledged and accepted in writing by the Engineer and the City.

5.2 PAYMENT PROCEDURE

5.2.1 The City shall pay the Contract Price to the Contractor as provided below.

5.2.2 PROGRESS PAYMENTS - Based upon the Contractor's Applications for Payment submitted to the Engineer and upon Certificates for Payment subsequently issued to the City by the Engineer, the City shall make progress payments to the Contractor on account of the Contract Price.

5.2.3 APPLICATION FOR PAYMENT - On or before the 25th day of each month after commencement of the Work, the Contractor shall submit an Application for Payment for the period ending the 15th day of the month to the Engineer in such form and manner, and with such supporting data and content, as the City or the Engineer may require. The Contractor may request payment for that portion of the Contract Price properly allocable to Contract requirements properly provided and to labor, materials and equipment properly incorporated in the Work, less retainage and less the total amount of previous payments received from the City. Such Application for Payment shall be signed by the Contractor and shall constitute the Contractor's representation that the Work has progressed to the level for which payment is requested in accordance with the Schedule of Values, that the Work has been properly installed or performed in full compliance with this Contract, and that the Contractor knows of no reason why payment should not be made as requested. Thereafter, the Engineer will review the Application for Payment and may also review the Work at the Project site or elsewhere to determine whether the quantity and quality of the Work is as represented in the Application for Payment and is as required by this Contract. The Engineer shall determine and certify to the City the amount properly owing to the Contractor. The City shall make partial payments on account of the Contract Price to the Contractor within thirty (30) days following the Engineer's receipt and approval of each Application for Payment. The amount of each partial payment shall be the amount certified for payment by the Engineer less such amounts, if any, otherwise owing by the Contractor to the City or which the City shall have the right to withhold as authorized by this Contract. The Engineer's certification of the Contractor's Application for Payment shall not preclude the City from the exercise of any of its rights as set forth in Paragraph 5.3 hereinbelow.

5.2.4 STATEMENT OF DELAY - Each Application for Payment shall include a Statement of Delay showing the number of days lost due to inclement weather, conflicts with other City contractors, utilities, or design specifications, or other proper reasons. The failure to submit the Statement of Delay shall be a waiver of any claim for additional days or extensions of the scheduled completion date.

5.2.5 RETAINAGE - If the Contract Price set forth in Subparagraph 4.1.1 exceeds $400,000, the City shall withhold retainage of ten (10) percent from each progress payment to secure performance of the Contract and shall deposit in an interest-bearing account that portion of the retainage withheld that exceeds five (5) percent of the progress payment. If a different percentage is set forth in the Invitation to Bid, then that percentage shall apply.

5.2.6 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the City when installed at the Project site, regardless of the time of payment. The Contractor further warrants that upon submittal of an Application for Payment, all Work for which payments have been received from the City shall be free and clear of liens, claims, security interest or other encumbrances in favor of the Contractor or any other person or entity whatsoever.

5.2.7 The Contractor shall promptly pay each Subcontractor out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount to which such Subcontractor is entitled. In the event the City becomes informed that the Contractor has not paid a Subcontractor as herein provided, the City shall have the right, but not the duty, to issue future checks in payment to the Contractor of amounts otherwise due hereunder naming the Contractor and such Subcontractor as joint payees. Such joint check procedure, if employed by the City, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit the City to repeat the procedure in the future.

5.2.8 No progress payment, nor any use or occupancy of the Project by the City, shall be interpreted to constitute an acceptance of any Work not in strict compliance with this Contract.

SAMPLE

5.3 WITHHELD PAYMENT

5.3.1 The City may decline to make payment, may withhold funds, and, if necessary, may demand the return of some or all of the amounts previously paid to the Contractor, to protect the City from loss because of:

(a) defective Work not remedied by the Contractor or, in the opinion of the City, likely to be remedied by the Contractor;

(b) claims of third parties against the City or the City's property;

(c) failure by the Contractor to pay Subcontractors or others in a prompt and proper fashion;

(d) evidence that the balance of the Work cannot be completed in accordance with the Contract for the unpaid balance of the Contract Price,

(e) evidence that the Work will not be completed in the time required for substantial or final completion (final completion meaning the full and final completion of all work called for by this Contract and final acceptance by the Engineer and the City);

(f) persistent failure to carry out the Work in accordance with the Contract;

(g) damage to the City or a third party to whom the City is, or may be, liable.

(h) failure to submit an updated project schedule in accordance with Subparagraph 3.2.3.

(i) failure to submit record drawings in accordance with Subparagraph 7.9.1.

In the event that the City makes written demand upon the Contractor for amounts previously paid by the City as contemplated in this Subparagraph 5.3.1, the Contractor shall promptly comply with such demand. The City shall have no duty to third parties to withhold payment to the Contractor and shall incur no liability for a failure to withhold funds.

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5.4 UNEXCUSED FAILURE TO PAY

5.4.1 If within twenty (20) days after the date established herein for payment to the Contractor by the City, the City, without cause or basis hereunder, fails to pay the Contractor any amount then due and payable to the Contractor, then the Contractor may after ten (10) additional days' written notice to the City and the Engineer, and without prejudice to any other available rights or remedies it may have, stop the Work until payment of those amounts due from the City have been received. Late payments shall not accrue interest or other late charges.

5.5 CERTIFICATE OF SUBSTANTIAL COMPLETION

5.5.1 When the Contractor believes that the Work is substantially complete, the Contractor shall submit to the Engineer a list of items to be completed or corrected. When the Engineer and the City on the basis of an inspection determine that the Work is in fact substantially complete, the Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall state the responsibilities of the City and the Contractor for Project security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed therein. In no event, however, shall the date of Final Completion be delayed. Guarantees required by the Contract shall commence on the date of Substantial Completion of the Work; however, the maintenance bond required herein, and the assurances given thereunder, shall commence of and from the date of final acceptance of the work by the City. The Certificate of Substantial Completion shall be submitted to the City and the Contractor for their written acceptance of the responsibilities assigned to them in such certificate.

Upon Substantial Completion of the Work, and execution by both the City and the Contractor of the Certificate of Substantial Completion, the City shall pay the Contractor for all work completed to date, less retainage.

5.6 COMPLETION AND FINAL PAYMENT

5.6.1 When all of the Work is finally complete and the Contractor is ready for a final inspection, it shall notify the City and the Engineer thereof in writing. Thereupon, the Engineer will make final inspection of the Work and, if the Work is complete in full accordance with this Contract and this Contract has been fully performed, the Engineer will promptly issue a final Certificate for Payment certifying to the City that the Project is complete and the Contractor is entitled to the remainder of the unpaid Contract Price (including retainage and the interest accrued on the retainage in excess of five (5) percent if the Contract Price is in excess of $400,000), plus an early completion bonus, if any, less any amount withheld pursuant to this Contract. If the Engineer is unable to issue its final Certificate for Payment and is required to repeat its final inspection of the Work, the Contractor shall bear the cost of such repeat final inspection(s) which cost may be deducted by the City from the Contractor's final payment.

5.6.1.1 If the Contractor fails to achieve final completion within the time fixed therefor by the Engineer in its Certificate of Substantial Completion, the Contractor shall pay the City the sum set forth hereinabove as liquidated damages per day for each and every calendar day of unexcused delay in achieving final completion beyond the date set forth herein for final completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by the City, estimated at or before the time of executing this Contract. When the City reasonably believes that final completion will be inexcusably delayed, the City shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the City to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving final completion, or any part thereof, for which the City has withheld payment, the City shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. Liquidated damages shall be deducted first from any earned early completion bonus, then from any sums otherwise due to the Contractor.

5.6.2 The Contractor shall not be entitled to final payment unless and until it submits to the Engineer its affidavit that all payrolls, invoices for materials and equipment, and other liabilities connected with the Work for which the City, or the City's property might be responsible, have been fully paid or otherwise satisfied; releases and waivers of lien from all Subcontractors of the Contractor and of any and all other parties required by the Engineer or the City; consent of Surety, if any, to final payment. If any third party fails or refuses to provide a release of claim or waiver of lien as required by the City, the Contractor shall furnish a bond satisfactory to the City to discharge any such lien or indemnify the City from liability.

5.6.3 The City shall make final payment of all sums due the Contractor within thirty (30) days of the Engineer's execution of a final Certificate for Payment.

5.6.4 Acceptance of final payment shall constitute a waiver of all claims against the City by the Contractor except for those claims previously made in writing against the City by the Contractor, pending at the time of final payment, and identified in writing by the Contractor as unsettled at the time of its request for final payment.

5.6.5 Other than interest on retainage in excess of 5% under Paragraph 5.2.5, under no circumstances shall Contractor be entitled to receive interest on any payments or monies due Contractor by the City, whether the amount on which the interest may accrue is timely, late, wrongfully withheld, or an assessment of damages of any kind.

ARTICLE VI

THE CITY

6.1 INFORMATION, SERVICES AND THINGS REQUIRED FROM CITY

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6.1.1 The City shall furnish to the Contractor, at the time of executing this Contract, any and all written and tangible material in its possession concerning conditions below ground at the site of the Project. Such written and tangible material is furnished to the Contractor only in order to make complete disclosure of such material and for no other purpose. By furnishing such material, the City does not represent, warrant, or guarantee its accuracy either in whole, in part, implicitly or explicitly, or at all, and shall have no liability therefor. The City shall also furnish surveys, legal limitations and utility locations (if known), and a legal description of the Project site.

6.1.2 Excluding permits and fees normally the responsibility of the Contractor, the City shall obtain all approvals, easements, and the like required for construction and shall pay for necessary assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

6.1.3 The City shall furnish the Contractor, free of charge, two copies of the Contract Documents for execution of the Work.

6.2 RIGHT TO STOP WORK

6.2.1 If the Contractor persistently fails or refuses to perform the Work in accordance with this Contract, if the Contractor fails to meet milestones set forth in approved construction schedules, if the City has sufficient reason to believe that the Contractor is not and will not complete the Project by the scheduled completion date, or if the best interests of the public health, safety or welfare so require, the City may order the Contractor to stop the Work, or any described portion thereof, until the cause for stoppage has been corrected, no longer exists, or the City orders that Work be resumed. In such event, the Contractor shall immediately obey such order.

6.3 CITY'S RIGHT TO PERFORM WORK

6.3.1 If the Contractor's Work is stopped by the City under Paragraph 6.2, and the Contractor fails within seven (7) days of such stoppage to provide adequate assurance to the City that the cause of such stoppage will be eliminated or corrected, then the City may, without prejudice to any other rights or remedies the City may have against the Contractor, proceed to carry out the subject Work. In such a situation, an appropriate Change Order shall be issued deducting from the Contract Price the cost of correcting the subject deficiencies, plus compensation for the Engineer's additional services and expenses necessitated thereby, if any. If the unpaid portion of the Contract Price is insufficient to cover the amount due the City, the Contractor shall pay the difference to the City.

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ARTICLE VII THE

CONTRACTOR

7.1 MUST FOLLOW CONTRACT

7.1.1 The Contractor shall perform no part of the Work at any time without adequate Contract Documents or, as appropriate, approved Shop Drawings, Product Data or Samples for such portion of the Work. If the Contractor performs any of the Work knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Engineer, the Contractor shall bear responsibility for such performance and shall bear the cost of correction. The Contractor shall perform the Work strictly in accordance with this Contract

7.2 PROSECUTION OF WORK

7.3.1 The Contractor shall supervise and direct the Work using the Contractor's best skill, effort and attention. The Contractor shall be responsible to the City for any and all acts or omissions of the Contractor, its employees and others engaged in the Work on behalf of the Contractor.

7.3.2 The Contractor shall give adequate attention to the faithful prosecution of the Work and the timely completion of this Contract, with authority to determine the manner and means of performing such Work, so long as such methods insure timely completion and proper performance.

7.3.3 The Contractor shall exercise all appropriate means and measures to insure a safe and secure jobsite in order to avoid and prevent injury, damage or loss to persons or property.

7.3.4 The City will not interfere with the Contractor's manner and means of performing the Work. However, the City's insistence on strict compliance with the Contract shall not be regarded as an interference with the Contractor's manner and means. In the event that any part of the Work is not in strict compliance with the Contract, the Contractor is and shall be estopped from claiming any interference by the City or Engineer with the Contractor's manner and means of performing that part of the Work.

7.4 WARRANTY

7.4.1 The Contractor warrants to the City that all labor furnished to progress the Work under this Contract will be competent to perform the tasks undertaken, that the product of such labor will yield only first-class results, that materials and equipment furnished will be of good quality and new unless otherwise permitted by this Contract, and that the Work will be of good quality, free from faults and defects and in strict conformance with this Contract. All Work not conforming to these requirements may be considered defective. THE CONTRACTOR WARRANTS AND GUARANTIES THAT IT SHALL COMPLETE THE WORK AND ACHIEVE SUBSTANTIAL COMPLETION BY THE SCHEDULED COMPLETION DATE, STRICTLY IN ACCORDANCE WITH THIS CONTRACT. DEFECTIVE WORK OR MATERIALS SHALL BE FIXED, REPAIRED OR REPLACED FREE OF CHARGE OR COST TO THE CITY.

7.5 PERMITS; FEES; LICENSES

The Contractor shall obtain and pay for all permits, fees and licenses necessary and ordinary for the Work. The Contractor shall comply with all lawful requirements applicable to the Work and shall give and maintain any and all notices required by applicable law pertaining to the Work.

7.6 SUPERVISION

7.6.1 The Contractor shall employ and maintain at the Project site only competent supervisory personnel. Absent written instruction from the Contractor to the contrary, the superintendent shall be deemed the Contractor's authorized representative at the site and shall be authorized to receive and accept any and all communications from the City or the Engineer.

7.6.2 Key supervisory personnel assigned by the Contractor to this Project are as follows:

NAME	FUNCTION
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

So long as the individuals named above remain actively employed or retained by the Contractor, they shall perform the functions indicated next to their names unless the City agrees to the contrary in writing. In the event one or more

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individuals not listed above subsequently assume one or more of those functions listed above, the Contractor shall be bound by the provisions of this Subparagraph 7.6.2 as though such individuals had been listed above.

7.7 WORK SCHEDULE

7.7.1 At the pre-construction meeting, the Contractor shall submit to the City and the Engineer for their information, the Contractor's schedule for completing the Work (also referred to herein as the construction schedule). The Contractor's schedule shall be revised no less frequently than monthly (unless the parties otherwise agree in writing) and shall be revised to reflect conditions encountered from time to time and shall be related to the entire Project. Each such revision shall be furnished to the City and the Engineer.

7.7.2 The Contractor's schedule for completing the Work and any revised schedules, shall demonstrate achievement of substantial completion by the scheduled completion date. Failure by the Contractor to strictly comply with the provisions of this Paragraph 7.7 shall constitute a default and a material breach of this Contract.

7.8 ON-SITE DRAWINGS

7.8.1 The Contractor shall continuously maintain at the site, for the benefit of the City and the Engineer, one record copy of this Contract marked to record on a current basis changes, selections and modifications made during construction. Additionally, the Contractor shall maintain at the site for the City and Engineer the approved Shop Drawings, Product Data, Samples and other similar required submittals. Upon final completion of the Work, all of these record documents shall be delivered to the City.

7.9 RECORD DRAWINGS/PLANS, AS-BUILT PLANS, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

7.9.1 The Contractor shall submit, with each Application for Payment, As-Built plans for any and each part or portion of the Project that varies from the Engineer's plans and specifications and the Contract Documents.

7.9.2 Shop Drawings, Product Data, Samples and other submittals from the Contractor do not constitute Contract Documents. Their purpose is merely to demonstrate the manner in which the Contractor intends to implement the Work in conformance with information received from the Contract Documents.

7.9.3 The Contractor shall not perform any portion of the Work requiring submittal and review of Shop Drawings, Product Data or Samples unless and until such submittal shall have been approved by the Engineer. Approval by the Engineer, however, shall not be evidence that Work installed pursuant thereto conforms to the requirements of this Contract.

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7.10 CLEANING THE SITE AND THE PROJECT

7.10.1 The Contractor shall keep the site reasonably clean during performance of the Work. The Contractor shall clean the site and the Project and remove all waste, rubbish, temporary structures, and other materials during construction and, upon completion of construction, shall clean the site and remove all such material together with all of the Contractor's property therefrom. Contractor shall dispose of all refuse at a landfill approved by the Texas Commission on Environmental Quality. The Contractor shall further restore all property damaged during the prosecution of the Work and shall leave the site in a clean and presentable condition. No additional payment shall be made by the City for this work, the compensation having been considered and included in the contract price.

7.11 ACCESS TO WORK AND INSPECTIONS

7.11.1 The City and the Engineer shall have access to the Work at all times from commencement of the Work through final completion. The Contractor shall take whatever steps necessary to provide access when requested. When reasonably requested by the City or the Engineer, the Contractor shall perform or cause to be performed such testing as may be necessary or appropriate to insure suitability of the jobsite or the Work's compliance with the Contract requirements.

7.12 INDEMNITY AND DISCLAIMER

7.12.1 CITY SHALL NOT BE LIABLE OR RESPONSIBLE FOR, AND SHALL BE INDEMNIFIED, DEFENDED, HELD HARMLESS AND RELEASED BY CONTRACTOR FROM AND AGAINST ANY AND ALL SUITS, ACTIONS, LOSSES, DAMAGES, CLAIMS, OR LIABILITY OF ANY CHARACTER, TYPE, OR DESCRIPTION, INCLUDING ALL EXPENSES OF LITIGATION, COURT COSTS, AND ATTORNEY'S FEES, FOR INJURY OR DEATH TO ANY PERSON, INJURY OR LOSS TO ANY PROPERTY, OR ECONOMIC LOSS, RECEIVED OR SUSTAINED BY ANY PERSON OR PERSONS, INCLUDING THE CONTRACTOR, OR PROPERTY, DIRECTLY OR INDIRECTLY ARISING OUT OF, OR OCCASIONED BY THE PERFORMANCE OF CONTRACTOR UNDER THIS CONTRACT, INCLUDING CLAIMS AND DAMAGES ARISING IN WHOLE OR IN PART FROM THE NEGLIGENCE OF CITY, WITHOUT WAIVING THE CITY'S GOVERNMENTAL, SOVEREIGN OR OTHER IMMUNITIES OR DEFENSES AVAILABLE TO THE CITY UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW. IT IS THE EXPRESS INTENT OF THE PARTIES TO THIS CONTRACT THAT THE INDEMNITY PROVIDED FOR HEREIN IS AN INDEMNITY EXTENDED BY CONTRACTOR TO INDEMNIFY AND PROTECT CITY FROM THE CONSEQUENCES OF THE CONTRACTOR'S AS WELL AS THE CITY'S NEGLIGENCE, WHETHER SUCH NEGLIGENCE IS THE SOLE OR PARTIAL CAUSE OF ANY SUCH INJURY, DEATH, OR DAMAGE.

The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

7.12.2 The Contractor will secure and maintain contractual liability insurance to cover this indemnification agreement that will be primary and non-contributory as to any insurance maintained by the City for its own benefit, including self-insurance. In addition, Contractor shall obtain and file with City a standard form Certificate of Insurance evidencing the required coverage.

7.12.3 In claims against any person or entity indemnified under this Paragraph 7.12 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Paragraph 7.12 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

7.13 NONDISCRIMINATION

7.13.1 The Contractor shall not discriminate in any way against any person, employee or job applicant on the basis of race, color, creed, national original, religion, age, sex, or disability where reasonable accommodations can be effected to enable the person to perform the essential functions of the job. The Contractor shall further insure that the foregoing nondiscrimination requirement shall be made a part and requirement of each subcontract on this Project.

7.14 PREVAILING WAGE RATES

7.14.1 The Contractor shall comply in all respects with all requirements imposed by any laws, ordinances or resolutions applicable to the Project with regard to the minimum prevailing wage rates for all classes of employees, laborers, subcontractors, mechanics, workmen and persons furnishing labor and services to the Project. The City has adopted a Prevailing Wage Rate Schedule, available to the Contractor by request (or attached to this contract as a part of the exhibits), which specifies the classes and wage rates to be paid to all persons. The Contractor shall pay not less than the minimum wage rates established thereby for each class, craft or type of labor, workman, or

SAMPLE

mechanic employed in the execution of this Contract. The failure of the Contractor to comply with this requirement shall result in the forfeiture to the City of a sum of not less than Sixty Dollars ($60.00) for each person per day, or portion thereof, that such person is paid less than the prevailing rate. Upon request by the City, Contractor shall make available for inspection and copying its books and records, including but not limited to its payroll records, account information and other documents as may be required by the City to insure compliance with this provision.

7.15 JOB SITE SAFETY PRECAUTIONS

7.15.1 The Contractor shall at all times exercise reasonable precautions for the safety of its employees, laborers, subcontractors, mechanics, workmen and others on and near the jobsite and shall comply with all laws, ordinances, regulations, and standards of federal, state and local safety laws and regulations. The Contractor shall provide such machinery guards, safe walk-ways, ladders, bridges, and other safety devices as may be necessary or appropriate to insure a safe and secure jobsite and shall require its subcontractors to comply with this requirement. The Contractor shall immediately comply with any and all safety requirements imposed by the Engineer during the progress of the Work.

7.16 WARNING DEVICES AND BARRICADES

7.16.1 The Contractor shall furnish and maintain such warning devices, barricades, lights, signs, pavement markings, and other devices as may be necessary or appropriate or required by the Engineer to protect persons or property in, near or adjacent to the jobsite. No separate compensation shall be paid to the Contractor for such measures. Where the Work is being conducted in, upon or near streets, alleys, sidewalks, or other rights-of-way, the Contractor shall insure the placement, maintenance and operation of any and all such warning devices as may be required by the City and shall do so until no longer required by the City. Such devices shall be in compliance with and conform to the manual and specifications for the uniform system of traffic control devices adopted by the Texas Department of Transportation.

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7.17 PROTECTION OF UTILITIES AND OTHER CONTRACTORS

7.17.1 The Contractor shall use best efforts to leave undisturbed and uninterrupted all utilities and utility services provided to the jobsite or which presently exists at, above or beneath the location where the Work is to be performed. In the event that any utility or utility service is disturbed or damaged during the progress of the Work, the Contractor shall forthwith repair, remedy or restore the utility at Contractor's sole expense. The Contractor shall coordinate any utility conflicts with the owner of the utility and no extension of time will be requested or given if adequate coordination is not provided by Contractor.

7.17.2 The Contractor understands and acknowledges that other contractors of the City or of other entities may be present at the jobsite performing other work unrelated to the Project. The Contractor shall use best efforts to work around other contractors without impeding the work of others while still adhering to the scheduled completion date. In the event that the Contractor's work is or may be delayed by any other person, the Contractor shall immediately give notice thereof to the Engineer and shall request a written Change Order in accordance with the procedures set forth by this Contract. The Contractor's failure to provide such notice and to request such Change Order shall constitute a waiver of any and all claims associated therewith.

ARTICLE VIII CONTRACT

ADMINISTRATION

8.1 THE ENGINEER

8.1.1 When used in this Contract the term "Engineer" does not necessarily denote a duly licensed, trained or certified engineer; as used herein, the term shall be used interchangeably and shall mean a designated Engineer, Engineer, or Contract Administrator (who may not be an architect or engineer) for the City, said person to be

designated or re-designated by the City prior to or at any time during the Work hereunder. The Engineer may be an employee of the City or may be retained by the City as an independent contractor but, in either event, the Engineer's duties and authority shall be as set forth hereinafter. The Contractor understands and agrees that it shall abide by the decisions and instructions of the Engineer notwithstanding the contractual relationship between the City and Engineer, the title of Contract Administrator, or the fact that the Engineer is an employee of the City.

In the event the City should find it necessary or convenient to replace the Engineer, the City shall retain a replacement Engineer and the status of the replacement Engineer shall be that of the former Engineer.

8.2 ENGINEER'S ADMINISTRATION

8.2.1 The Engineer, unless otherwise directed by the City in writing, will perform those duties and discharge those responsibilities allocated to the Engineer as set forth in this Contract. The Engineer shall be the City's representative from the effective date of this Contract until final payment has been made.

8.2.2 The City and the Contractor shall communicate with each other in the first instance through the Engineer.

8.2.3 The Engineer shall be the initial interpreter of the requirements of the drawings and specifications and the judge of the performance thereunder by the Contractor. The Engineer shall render written or graphic interpretations necessary for the proper execution or progress of the Work with reasonable promptness on request of the Contractor.

8.2.4 The Engineer will review the Contractor's Applications for Payment and will certify to the City for payment to the Contractor, those amounts then due the Contractor as provided in this Contract.

8.2.5 The Engineer shall have authority to reject Work which is defective or does not conform to the requirements of this Contract. If the Engineer deems it necessary or advisable, the Engineer shall have authority to require additional inspection or testing of the Work for compliance with Contract requirements.

8.2.6 The Engineer will review and approve, or take other appropriate action as necessary, concerning the Contractor's submittals including Shop Drawings, Product Data and Samples. Such review, approval or other action shall be for the sole purpose of determining conformance with the design concept and information given through the Contract Documents.

8.2.7 The Engineer will prepare Change Orders and may authorize minor changes in the Work by Field Order as provided elsewhere herein.

8.2.8 The Engineer shall, upon written request from the Contractor, conduct inspections to determine the date of Substantial Completion and the date of final completion, will receive and forward to the City for the City's review and records, written warranties and related documents required by this Contract and will issue a final Certificate for Payment upon compliance with the requirements of this Contract.

8.2.9 The Engineer's decisions in matters relating to aesthetic effect shall be final if consistent with the intent of this Contract.

8.3 CLAIMS BY THE CONTRACTOR

8.3.1 The Engineer shall determine all claims and matters in dispute between the Contractor and City with regard to the execution, progress, or sufficiency of the Work or the interpretation of the Contract Documents, including but not limited to the plans and specifications. Any dispute shall be submitted in writing to the Engineer within seven (7) days of the event or occurrence or the first appearance of the condition giving rise to the claim or dispute and the Engineer shall render a written decision within a reasonable time thereafter. The Engineer's decisions shall be final and binding on the parties. In the event that either party objects to the Engineer's determination as to any submitted dispute, that party shall submit a written objection to the Engineer and the opposing party within ten (10) days of receipt of the Engineer's written determination in order to preserve the objection. Failure to so object shall constitute a waiver of the objection for all purposes.

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8.3.2 Pending final resolution of any claim of the Contractor, the Contractor shall diligently proceed with performance of this Contract and the City shall continue to make payments to the Contractor in accordance with this Contract.

8.3.3 CLAIMS FOR CONCEALED, LATENT OR UNKNOWN CONDITIONS - The Contractor expressly represents that it has been provided with an adequate opportunity to inspect the Project site and thoroughly review the Contract Documents and plans and specifications prior to submission of its bid and the City's acceptance of the bid. Subject to the conditions hereof, Contractor assumes full responsibility and risk for any concealed, latent or unknown condition which may affect the Work. No claims for extra work or additional compensation shall be made by Contractor in connection with concealed, latent or unknown conditions except as expressly provided herein. Should concealed, latent or unknown conditions encountered in the performance of the Work (a) below the surface of the ground or (b) in an existing structure be at variance with the conditions indicated by this Contract, or should unknown conditions of an unusual nature differing materially from those ordinarily encountered in the area and generally recognized as inherent in Work of the character provided for in this Contract, be encountered, the Contract Price shall be equitably adjusted by Change Order upon the written notice and claim by either party made within seven (7) days after the first observance of the condition. As a condition precedent to the City having any liability to the Contractor for concealed or unknown conditions, the Contractor must give the City and the Engineer written notice of, and an opportunity to observe, the condition prior to disturbing it. The failure by the Contractor to make the written notice and claim as provided in this Subparagraph shall constitute a waiver by the Contractor of any claim arising out of or relating to such concealed, latent or unknown condition and the Contractor thereby assumes all risks and additional costs associated therewith.

8.4 EXTRA WORK

8.4.1 The Contractor shall not claim, request or demand any sum from the City for Extra Work or for additional costs, and hereby waives all such claims, requests and demands and any right to assert same, unless the conditions of this subparagraph are strictly complied with. "Extra Work" is defined herein to mean any labor, service, materials, equipment, supplies or charges that are directly or indirectly related to the Work, the Project or the Project site, that is not necessarily or fairly required or implied by the Contract Documents.

8.4.2 The parties acknowledge and agree that there shall be no payment made by the City to the Contractor without a written agreement (either a separate contract or a written Change Order) signed by the parties. Should the Contractor perform Extra Work or be requested to perform Extra Work by the Engineer or City, it shall be the Contractor's obligation and duty to first apply for and obtain a written Change Order, approved by the Engineer and executed by the City. The Contractor's failure to obtain a written, signed Change Order prior to commencement of Extra Work shall constitute a complete and final waiver of any right for compensation for the Extra Work.

8.5 CLAIMS FOR ADDITIONAL COSTS OR TIME; CONTRACT PRICE INCREASE

8.5.1 If the Contractor wishes to make a claim for an increase in the Contract Price, as a condition precedent to any liability of the City therefor, the Contractor shall give the Engineer written notice of such claim within seven (7) days after the occurrence of the event, or the first appearance of the condition, giving rise to such claim. Such notice shall be given by the Contractor before proceeding to execute any additional or changed Work. The failure by the Contractor to give such notice and to give such notice prior to executing the Work shall constitute a waiver of any right to or claim for additional compensation.

8.5.2 In connection with any claim by the Contractor against the City for compensation in excess of the Contract Price, any liability of the City for the Contractor's costs shall be strictly limited to direct costs incurred by the Contractor and shall in no event include indirect costs or consequential damages of the Contractor. The City shall not be liable to the Contractor for claims of third parties, including Subcontractors. The City shall not be liable to the Contractor for any claims based upon delay to the Contractor for any reason whatsoever including any act or neglect on the part of the City.

8.5.3 If the Contractor is delayed in progressing any task which at the time of the delay is then critical or which during the delay becomes critical, as the sole result of any act or neglect to act by the City or someone acting in the City's behalf, or by changes ordered in the Work, unusual delay in transportation, unusually adverse weather

SAMPLE

conditions not reasonably anticipated, fire or any causes beyond the Contractor's control, then the date for achieving Substantial Completion of the Work shall be extended upon the written notice and claim of the Contractor to the City and the Engineer, for such reasonable time as the Engineer may determine. Any notice and claim for an extension of time by the Contractor shall be made not more than seven (7) days after the occurrence of the event or the first appearance of the condition giving rise to the claim and shall set forth in detail the Contractor's basis for requiring additional time in which to complete the Project. In the event the delay to the Contractor is a continuing one, only one notice and claim for additional time shall be necessary. If the Contractor fails to make such claim as required in this Subparagraph, any claim for an extension of time shall be waived. The procedures and remedies provided by this provision shall be the sole remedy of Contractor and Contractor shall not assert nor be entitled to any additional delays or damages associated therewith.

8.6 FIELD ORDERS

8.6.1 The Engineer shall have authority to order minor changes in the Work not involving a change in the Contract Price or in Contract Time and not inconsistent with the intent of the Contract. Such changes shall be effected by Field Order and shall be binding upon the Contractor. The Contractor shall carry out such Field Orders promptly.

8.7 MEDIATION

8.7.1 In the event that a dispute arises under the terms of this Contract, following an adverse determination by the Engineer and proper preservation of the issue as required herein, the parties agree to submit to mediation. In such event, the parties shall agree to a designated person to serve as mediator and each party shall be responsible for payment of one-half of the total mediation fees. The parties shall submit the dispute to mediation as soon as practical and in no event later than one (1) year after the Engineer's written decision on the matter. At least one designated representative of each party must attend and participate in good faith in an effort to resolve the matters in dispute.

8.7.2 In no event shall the foregoing provision justify or authorize any delay in the progress of the Work; the parties shall abide by the decision of the Engineer in accomplishing the timely completion of the Project.

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ARTICLE IX

SUBCONTRACTORS

9.1 DEFINITION

9.1.1 A Subcontractor is a person or entity that has a direct contract with the Contractor to perform a portion of the Work. No Subcontractor shall be in privity with the City.

9.2 AWARD OF SUBCONTRACTS

9.2.1 Upon execution of the Contract, the Contractor shall furnish the City, in writing, the names of persons or entities proposed by the Contractor to act as a Subcontractor on the Project. The City shall promptly reply to the Contractor, in writing, stating any objections the City may have to such proposed Subcontractor. The Contractor shall not enter into a subcontract with a proposed Subcontractor with reference to whom the City has made timely objection. The Contractor shall not be required to subcontract with any party to whom the Contractor has objection.

9.2.2 All subcontracts shall afford the Contractor rights against the Subcontractor which correspond to those rights afforded to the City against the Contractor herein, including those rights afforded to the City by Subparagraph 12.2.1 below. All subcontracts shall incorporate by reference the provisions hereof and shall provide that no claims, causes or demands shall be made by any Subcontractor against the City.

9.2.3 The Contractor shall indemnify, defend and hold harmless the City from and against any and all claims, demands, causes of action, damage, and liability asserted or made against the City by or on behalf of any Subcontractor.

ARTICLE X CHANGES IN

THE WORK

10.1 CHANGES PERMITTED

10.1.1 Changes in the Work within the general scope of this Contract, consisting of additions, deletions, revisions, or any combination thereof, may be ordered without invalidating this Contract, by Change Order or by Field Order.

10.1.2 Changes in the Work shall be performed under applicable provisions of this Contract and the Contractor shall proceed promptly with such changes.

10.2 CHANGE ORDER DEFINED

10.2.1 Change Order shall mean a written order to the Contractor executed by the City and the Engineer, issued after execution of this Contract, authorizing and directing a change in the Work or an adjustment in the Contract Price or the Contract Time, or any combination thereof. The Contract Price and the Contract Time may be changed only by written Change Order.

10.3 CHANGES IN THE CONTRACT PRICE

10.3.1 Any change in the Contract Price resulting from a Change Order shall be determined as follows: (a) by mutual agreement between the City and the Contractor as evidenced by (1) the change in the Contract Price being set forth in the Change Order, (2) such change in the Contract Price, together with any conditions or requirements related thereto, being initialed by both parties, and (3) the Contractor's execution of the Change Order, or (b) if no mutual agreement occurs between the City and the Contractor, then, as provided in Subparagraph 10.3.2 below.

10.3.2 If no mutual agreement occurs between the City and the Contractor as contemplated in Subparagraph 10.3.1 above, the change in the Contract Price, if any, shall then be determined by the Engineer on the basis of the reasonable expenditures or savings of those performing, deleting or revising the Work attributable to the change, including, in the case of an increase or decrease in the Contract Price, a reasonable allowance for direct job site overhead and profit. In such case, the Contractor shall present, in such form and with such content as the City or the Engineer require, an itemized accounting of such expenditures or savings, plus appropriate supporting data for inclusion in a Change Order. Reasonable expenditures or savings shall be limited to the following: reasonable costs of materials, supplies, or equipment including delivery costs, reasonable costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance, reasonable rental costs of machinery and equipment exclusive of hand tools whether rented from the Contractor or others, reasonable costs of premiums for all bonds and insurance, permit fees, and sales, use or other taxes related to the Work, and reasonable cost of direct supervision and jobsite field office overhead directly attributable to the change. In no event shall any expenditure or savings associated with the Contractor's home office or other non-jobsite overhead expense be included in any change in the Contract Price. Pending final determination of reasonable expenditures or savings to the City, payments on account shall be made to the Contractor on the Engineer's Certificate for Payment.

10.3.3 If unit prices are provided in the Contract, and if the quantities contemplated are so changed in a proposed Change Order that application of such unit prices to the quantities of Work proposed will cause substantial inequity to the City or to the Contractor, the applicable unit prices shall be equitably adjusted.

SAMPLE

10.4 MINOR CHANGES

10.4.1 The Engineer shall have authority to order minor changes in the Work not involving a change in the Contract Price or an extension of the Contract Time and not inconsistent with the intent of this Contract. Such minor changes shall be made by written Field Order, and shall be binding upon the City and the Contractor. The Contractor shall promptly carry out such written Field Orders.

10.5 EFFECT OF EXECUTED CHANGE ORDER

10.5.1 The execution of a Change Order by the Contractor shall constitute conclusive evidence of the Contractor's agreement to the ordered changes in the Work, this Contract as thus amended, the Contract Price and the Contract Time. The Contractor, by executing the Change Order, waives and forever releases any claim against the City for additional time or compensation for matters relating to or arising out of or resulting from the Work included within or affected by the executed Change Order.

10.6 NOTICE TO SURETY; CONSENT

10.6.1 The Contractor shall notify and obtain the consent and approval of the Contractor's surety with reference to all Change Orders if such notice, consent or approval are required by the Contractor's surety or by law. The Contractor's execution of the Change Order shall constitute the Contractor's warranty to the City that the surety has been notified of and consents to, such Change Order and the surety shall be conclusively deemed to have been notified of such Change Order and to have expressly consented thereto.

SAMPLE

ARTICLE XI

UNCOVERING AND CORRECTING WORK

11.1 UNCOVERING WORK

11.1.1 If any of the Work is covered contrary to the Engineer's request or to any provisions of this Contract, it shall, if required by the Engineer or the City, be uncovered for the Engineer's inspection and shall be properly replaced at the Contractor's expense without change in the Contract Time or Contract Price.

11.1.2 If any of the Work is covered in a manner consistent with the Engineer's request or the provisions of this Contract, it shall, if required by the Engineer or City, be uncovered for the Engineer's inspection. If such Work conforms strictly to this Contract, costs of uncovering and proper replacement shall by Change Order be charged to the City. If such Work does not strictly conform to this Contract, the Contractor shall pay the costs of uncovering and proper replacement.

11.2 CORRECTING WORK

11.2.1 The Contractor shall immediately proceed to correct Work rejected by the Engineer as defective or failing to conform to this Contract. The Contractor shall pay all costs and expenses associated with correcting such rejected Work, including any additional testing and inspections, and reimbursement to the City for the Engineer's services and expenses made necessary thereby.

11.2.2 If within four (4) years after Substantial Completion of the Work any of the Work is found to be defective or not in accordance with this Contract, the Contractor shall correct it promptly upon receipt of written notice from the City. This obligation shall survive final payment by the City and termination of this Contract. With respect to Work first performed and completed after Substantial Completion, this four year obligation to specifically correct defective and nonconforming Work shall be extended by the period of time which elapses between Substantial Completion and completion of the subject Work.

11.2.3 Nothing contained in this Paragraph 11.2 shall establish any period of limitation with respect to other obligations which the Contractor has under this Contract. Establishment of the four year time period in Subparagraph 11.2.2 relates only to the duty of the Contractor to specifically correct the Work.

11.3 CITY MAY ACCEPT DEFECTIVE OR NONCONFORMING WORK

11.3.1 If the City chooses to accept defective or nonconforming Work, the City may do so at its sole discretion. In such event, the Contract Price shall be reduced by the greater of (a) the reasonable cost of removing and correcting the defective or nonconforming Work, and (b) the difference between the fair market value of the Project as constructed and the fair market value of the Project had it not been constructed in such a manner as to include defective or nonconforming Work. If the remaining portion of the unpaid Contract Price, if any, is insufficient to compensate the City for its acceptance of defective or nonconforming Work, the Contractor shall, upon written demand from the City, pay the City such remaining compensation for accepting defective or nonconforming Work.

ARTICLE XII

CONTRACT DEFAULT AND TERMINATION

SAMPLE

12.1 TERMINATION BY THE CONTRACTOR

12.1.1 If the Work is stopped for a period of ninety (90) days by an order of any court or other public authority, or as a result of an act of the Government, through no fault of the Contractor or any person or entity working directly or indirectly for the Contractor, the Contractor may, upon fifteen (15) days' written notice to the City and the Engineer, terminate performance under this Contract and recover from the City payment for the actual reasonable expenditures of the Contractor (as limited in Subparagraph 10.3.2 above) for all Work executed and for materials, equipment, tools, construction equipment and machinery actually purchased or rented solely for the Work, less any salvage value of any such items.

12.1.2 If the City shall persistently or repeatedly fail to perform any material obligation to the Contractor for a period of fifteen (15) days after receiving written notice from the Contractor of its intent to terminate hereunder, the City shall have fifteen (15) days to remedy its failure and if not so cured, the Contractor may terminate performance under this Contract by written notice to the Engineer and the City. In such event, the Contractor shall be entitled to recover from the City as though the City had terminated the Contractor's performance under this Contract for convenience pursuant to Subparagraph 12.2.1 hereunder.

12.2 TERMINATION BY THE CITY

12.2.1 FOR CONVENIENCE

12.2.1.1 The City may for any reason whatsoever terminate performance under this Contract by the Contractor for convenience. The City shall give written notice of such termination to the Contractor specifying when termination becomes effective.

12.2.1.2 The Contractor shall incur no further obligations in connection with the Work and the Contractor shall stop Work when such termination becomes effective. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders. The City may direct the Contractor to assign the Contractor's right, title and interest under terminated orders or subcontracts to the City or its designee.

12.2.1.3 The Contractor shall transfer title and deliver to the City such completed or partially completed Work and materials, equipment, parts, fixtures, information and Contract rights as the Contractor has.

12.2.1.4 (a) The Contractor shall submit a termination claim to the City and the Engineer specifying the amounts due because of the termination for convenience together with costs, pricing or other data required by the Engineer. If the Contractor fails to file a termination claim within one (1) year from the effective date of termination, the City shall pay the Contractor, an amount derived in accordance with subparagraph (c) below.

(b) The City and the Contractor may agree to the compensation, if any, due to the Contractor hereunder.

(c) Absent agreement to the amount due to the Contractor, the City shall pay the Contractor the following amounts:

(i) Contract prices for labor, materials, equipment and other services accepted under this Contract;

(ii) Reasonable costs incurred in preparing to perform and in performing the terminated portion of the Work, and in terminating the Contractor's performance, plus a fair and reasonable allowance for overhead and profit thereon (such profit shall not include anticipated profit or consequential damages), provided however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract would have been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss, if any;

(iii) Reasonable costs of settling and paying claims arising out of the termination of subcontracts or orders pursuant to Subparagraph 12.2.1.2 of this Paragraph. These costs shall not include amounts paid in accordance with other provisions hereof.

12.2.1.5 The total sum to be paid the Contractor under this Subparagraph 12.2.1 shall not exceed the total Contract Price, as properly by amounts withheld by the City and reduced by the amount of payments otherwise made, and shall in no event include duplication of payment.

12.2.2 FOR CAUSE

12.2.2.1 The following constitute grounds for termination of this Contract by the City:

(a) the Contractor's failure or refusal to prosecute the Work in a timely manner;

(b) The Contractor abandons the jobsite and fails to resume work within five (5) days of written notice thereof by the City;

(c) the Contractor fails to meet milestones or comply with approved construction schedules;

(d) the Contractor fails to grant or allow access to the jobsite by the City or Engineer;

(e) the Contractor fails to supply enough properly skilled workers, supervisory personnel or proper equipment or materials;

(f) the Contractor fails to make prompt payment to Subcontractors or for materials or labor;

(g) the Contractor persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction; or,

(h) the Contractor is otherwise guilty of a violation of a material provision of this Contract.

In the event of the occurrence of any one or more of the above events, the City may by written notice to the Contractor, without prejudice to any other right or remedy, terminate the employment of the Contractor, exclude the Contractor from the job site, and take possession of the site and of all materials, equipment, tools, construction

SAMPLE

equipment and machinery thereon owned by the Contractor and may finish the Work by whatever methods it may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished.

12.2.2.2 If the unpaid balance of the Contract Price does not exceed the cost of finishing the work, including compensation for the Engineer's additional services and expenses made necessary thereby, such difference shall be paid by the Contractor to the City. This obligation for payment shall survive the termination of the Contract.

12.2.2.3 In the event the employment of the Contractor is terminated by the City for cause pursuant to Subparagraph 12.2.2 and it is subsequently determined by a Court of competent jurisdiction that such termination was without cause, such termination shall thereupon be deemed a Termination for Convenience under Subparagraph 12.2.1 and the provisions of Subparagraph 12.2.1 shall apply.

12.3 USE OF THIRD-PARTY OVERSIGHT OR CONSTRUCTION MANAGER

12.3.1 Should the City allow the Contractor to continue its performance of Work notwithstanding an event of default specified in Subparagraph 12.2.2.1, or should there be an imminent potential of default, the City, at its sole option and within its sole discretion, may retain a third-party construction manager to document the events of default and oversee further progress of the Work. The use of a third-party construction manager shall not prevent the City from declaring the Contractor to be in default and the City may, at its sole option and within its sole discretion, terminate this Contract at any time. Should the City retain a third-party construction manager, the costs thereof shall be withheld from any amounts due Contractor upon termination. The City's exercise of this option shall be without prejudice to any other right or remedy available to the City by law or under this Contract.

SAMPLE

ARTICLE XIII
INSURANCE

13.1 CONTRACTOR SHALL MAINTAIN INSURANCE

13.1.1 The Contractor at its own expense shall purchase, maintain and keep in force during the life of this contract, adequate insurance that will protect the Contractor and/or any Additional Insured from claims which may arise out of or result from operations under this Contract. The insurance required shall provide adequate protections from all claims, whether such operations be by the Contractor or by any Additional Insured or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone whose acts of any of them may be liable and from any special hazards, such as blasting, which may be encountered in the performance of this contract in the amounts as shown below in Paragraph 13.2.1.

13.1.2 The Contractor shall not commence work on any Contract in the City until the Contractor has obtained all the insurance required under this paragraph and such insurance has been approved by the City.

13.2 TYPES AND AMOUNTS OF CONTRACTOR'S INSURANCE

13.2.1. The Contractor shall furnish and maintain during the life of the contract adequate Worker's Compensation and Commercial General Liability (Public) Insurance in such amounts as follows:

Type of Insurance	**Amount**
Worker's Compensation	As set forth in the Worker's Compensation Act.
Commercial General Liability (Public)	$1,000,000 Each Accident/Occurrence. $1,000,000 Aggregate $1,000,000 Products & Completed Operations Aggregate.
City's Protective Liability Insurance	$600,000 per occurrence $1,000,000 aggregate

Excess/Umbrella Liability $1,000,000 per occurrence w/drop down coverage

Endorsement CG 2503	Amendment Aggregate Limit of Insurance per Project or City's and Contractor's Protective Liability Insurance for the Project.
Automobile Liability	$500,000 Combined single limit per occurrence.

13.3 ADDITIONAL INSURED

13.3.1 The City and the Engineer shall be named as an additional insured on the Commercial General Liability (Public), City's Protective Liability, and Excess/Umbrella Liability Insurance Policies furnished by the Contractor.

13.4 WRITTEN NOTIFICATION

13.4.1 Each insurance policy shall contain a provision requiring that thirty (30) days prior to expiration, cancellation, non-renewal or any material change in coverage, a notice there of shall be given by certified mail to the City of Lucas, Attention: Stacy Henderson, 665 Country Club Road, Lucas, TX 75002-7561.

13.5 PREMIUMS AND ASSESSMENTS; SUBROGATION

13.5.1 Companies issuing the insurance policies shall have no recourse against the City for payment of any premiums or assessments for any deductibles which are at the sole responsibility and risk of the Contractor. Insurance Companies shall have no right of subrogation against the City or the Engineer.

13.6 CERTIFICATE OF INSURANCE

13.6.1 Proof that the insurance is in force shall be furnished to the City on Standard Certificate of Insurance Forms. In the event any insurance policy shown on the Certificate of Insurance has an expiration date that is prior to the completion and final acceptance of the project by the City, the contractor shall furnish the City proof of identical continued coverage no later than thirty (30) days prior to the expiration date shown on the Certificate of Insurance.

13.7 PRIMARY COVERAGE

13.7.1 The coverages provided herein shall be primary and noncontributory with any other insurance maintained by the City, for its benefit, including self-insurance.

13.8 WORKER'S COMPENSATION INSURANCE COVERAGE

13.8.1 The Contractor shall:

(1) provide coverage for its employees providing services on a project, for the duration of the project based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements;

SAMPLE

(2) provide a certificate of coverage showing workers' compensation coverage to the governmental entity prior to beginning work on the project;

(3) provide the governmental entity prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project;

(4) obtain from each person providing services on a project, and provide to the governmental entity:

(A) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(B) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project;

(7) post a notice on each project site informing all persons providing services on the project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage. This notice shall comply with the requirements established by the Division of Workers Compensation of the Texas Department of Insurance, or its successor agency.

And;

(8) contractually require each person with whom it contracts to provide services on a project, to:

(A) provide coverage based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements for all of its employees providing services on the project, for the duration of the project;

(B) provide a certificate of coverage to the contractor prior to that person beginning work on the project;

(C) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(D) obtain from each other person with whom it contracts, and provide to the Contractor:

(i) a certificate of coverage, prior to the other person beginning work on the project; and

(ii) prior to the end of the coverage period, a new certificate of coverage showing extension of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(E) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

SAMPLE

(F) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(G) contractually require each other person with whom it contracts, to perform as required by sub-paragraphs (A) - (G) of this paragraph, with the certificate of coverage to be provided to the person for whom they are providing services.

ARTICLE XIV

MISCELLANEOUS

14.1 LAWS AND ORDINANCES

14.1.1 The Contractor shall at all times and in all respects observe and comply with all federal, state and local laws, ordinances, and regulations applicable to the Project and Work. The Contractor shall further insure that all Subcontractors observe and comply with said laws, ordinances and regulations.

14.2 GOVERNING LAW

14.2.1 The Contract shall be governed by the laws of the State of Texas. Exclusive venue for any causes of action arising under the terms or provisions of this Contract or the Work to be performed hereunder shall be in the state courts of Collin County, Texas.

14.3 SUCCESSORS AND ASSIGNS

14.3.1 The City and Contractor bind themselves, their successors, assigns and legal representatives to the other party hereto and to successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in this Contract. The Contractor shall not assign this Contract without written consent of the City.

14.4 SURETY BONDS

14.4.1 The Contractor shall furnish separate performance and payment bonds to the City, according to the requirements set out in the bid documents and state statutes to guaranty full and faithful performance of the Contract by the Contractor and the full and final payment of all persons supplying labor or materials to the Project. Each bond required by the bid documents or state statute shall set forth a penal sum in an amount not less than the full Contract Price. Each bond furnished by the Contractor shall incorporate by reference the terms of this Contract as fully as though they were set forth verbatim in such bonds. In the event the Contract Price is adjusted by Change Order executed by the Contractor, the penal sum of both the performance bond and the payment bond shall be deemed increased by like amount. The performance and payment bonds furnished by the Contractor shall be in form suitable to the City and shall be executed by a surety, or sureties, reasonably suitable to the City and authorized to do business in the State of Texas.

14.4.2 If the Contract Price exceeds the sum of $25,000.00, the Contractor, upon execution of the Contract and prior to commencement of the Work, shall furnish to the City a two-year maintenance bond in the amount of one hundred percent (100%) of the Contract Price covering the guaranty and maintenance prescribed herein, written by an approved surety authorized and duly licensed to conduct business in the State of Texas. The cost of said maintenance bond shall be included in the Contractor's unit bid prices and shall be paid by the Contractor.

SAMPLE

14.5 FORCE MAJEURE

14.5.1 As used herein, "force majeure" means an incident, situation, or act of a third party that is beyond a party's reasonable control such as an act of God, an act of the public enemy, strikes or other labor disturbances (other than strikes within such party's own labor force), hurricanes, earthquakes, fires, floods, epidemics, embargoes, war, and riots. The Contractor will not be liable or responsible for its failure to perform any obligation under this Contract because of an event of Force Majeure, provided, however, that the Contractor submits notice thereof to the City and Engineer within seven (7) days of such an event, obtains a written Change Order, signed by all parties, that allows an extension of the scheduled completion date, and identifies the specific causes and number of days in the Statement of Delay submitted with the next ensuing Application for Payment. Notwithstanding, if the Contractor's failure to perform continues for more than twenty (20) calendar days, the City may at its option terminate this Agreement immediately and pursue such rights and remedies as may be allowed under Subparagraph 12.2.2 of this Contract.

14.6 IMMUNITIES; DEFENSES

14.6.1 Nothing in this Contract shall be deemed to waive any immunity, sovereign, governmental, official, qualified or otherwise, from liability or suit, which the City may have or assert, except as may be provided by law, all such immunities being hereby expressly retained.

14.7 NO RIGHTS IN THIRD PARTIES

14.7.1 The indemnification provisions of this Contract and the rights and remedies afforded herein are solely for the benefit of the parties to this Contract. Nothing in this Contract is intended nor shall be construed to grant, create or confer any right, benefit, interest or cause of action in any person not a party to this Contract, or to the public in general.

14.8 SEVERABILITY

14.8.1 The provisions of this Contract are herein declared to be severable; in the event that any term, provision or part hereof is determined to be invalid, void or unenforceable, such determination shall not affect the validity or enforceability of the remaining terms, provisions and parts, and this Contract shall be read as if the invalid, void or unenforceable portion had not been included herein.

14.9 AMENDMENTS; NO WAIVER

14.9.1 This Contract may be amended by the parties only by a written agreement duly executed by both parties. The failure of the City to object to any nonperformance or nonconforming work or to enforce any provision hereof shall in no event be regarded as or construed to be a waiver, release or modification of any term or provision in this Contract, nor shall such failure to object or enforce estop the City from insisting on strict compliance with this Contract or from recovering damages, costs or expenses arising as a result of such nonperformance or nonconforming work.

SAMPLE

14.10 NOTICES

14.10.1 All notices required by this Contract shall be in writing and presumed received when deposited in the mail properly addressed to the other party or Engineer at the address set forth herein or set forth in a written designation of change of address delivered to all parties and the Engineer.

EXECUTED in single or multiple originals, this _____ day of _____, 20_____

SAMPLE

Attachments

Terracon GeoReport

Geotechnical Engineering Report

West Lucas Road Reconstruction and Widening

Lucas, Collin County, Texas

October 7,2021

Terracon Project No. 94215036

Prepared for:

BCC Engineering Inc.

Bedford, Texas

Prepared by:

Terracon Consultants, Inc.

Dallas, Texas

October 7,2021

BCC Engineering Inc.
1903 Central Drive, Suite 102
Bedford, Texas 76021

Attn: Mr. Chris Meszler, P.E.
P: (817) 618 3640
E: cmeszler@bcceng.com

Re: Geotechnical Engineering Report
West Lucas Road Reconstruction and Widening
Angel Parkway to County Club Road
Lucas, Collin County, Texas
Terracon Project No. 94215036

Dear Mr. Meszler:

This report presents the findings of the subsurface exploration and provides geotechnical recommendations for the design and construction of pavements for the proposed project. This study was performed in general accordance with Subconsultant Agreement between Terracon Consultants (Terracon) and BCC Engineering (BCC) dated April 19, 2021.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Palasuntharam (Thusha) Thushanthan, P.E.
Project Manager

Siva P. Pathivada, P.E.
Principal

REPORT TOPICS

REPORT SUMMARY I
INTRODUCTION 1
PROJECT INFORMATION 2
GEOTECHNICAL CHARACTERIZATION 2
GEOTECHNICAL OVERVIEW 4
EARTHWORK 5
PAVEMENT RECOMMENDATIONS 9
GENERAL COMMENTS 15

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

FIGURES
EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
BORINGS DRILLED BY OTHERS
PAVEMENT CORE PHOTOS
PAVEMENT CALCULATIONS AND TRAFFIC DATA
SUPPORTING INFORMATION

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	This project includes the reconstruction and widening of West Lucas Road from Angel Parkway to Country Club Road in Lucas, Collin County, Texas.
Geotechnical Characterization	Subsurface conditions were evaluated by drilling 11 borings to depths of 15 feet by Terracon. Subsurface conditions generally consisted of expansive clay fills and clays to 6 to 13 feet followed by limestone to the boring termination depth of 15 feet. Two borings were terminated in clay strata. Groundwater was not observed in the borings. The soils are highly active and prone to shrinkage and swelling with variations in moisture content.
Earthwork	Existing soils can be used for general fill/ engineered fill for pavements.
Pavements	With subgrade prepared as noted in **Earthwork,** 10-inch Portland Cement Concrete (PCC) over 8-inch lime stabilized subgrade is recommended for West Lucas Road.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

West Lucas Road Reconstruction and Widening
Angel Parkway to County Club Road
Lucas, Collin County, Texas

Terracon Project No. 94215036

October 7,2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed reconstruction and widening of West Lucas Road in Lucas, Collin County, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Pavement design and construction

The geotechnical engineering scope of services for this project included drilling 11 borings to a depth of 15 feet, coring pavement at 11 boring locations, performing two double ring-infiltrometer, collecting two bulk samples, performing laboratory testing, and providing geotechnical engineering recommendations.

Maps showing the site and boring locations are shown in the **Site Location and Exploration Plan** section at the end of the report. The results of the laboratory tests are included on the boring logs in the **Exploration Results** section and in the **Exploration Testing and Procedures** section included at the end of in the report. Pavement core photos are included in **Pavement Core Photos** section.

PROJECT INFORMATION

Item	Description
Site Information	The reconstruction and widening of West Lucas Road is planned from Angel Parkway to Country Club Road in Lucas, Texas. The segment length is about 8,911 feet. Approximate GPS Coordinates: (33.085627-96.619951) to (33.085274, -96.591059) See **Site Location**
Existing Improvements	Asphalt pavements
Current Ground Cover	Asphalt pavements, grass and bare land
Existing Topography	Existing pavement grades vary from elevations 646 to 614 feet sloping toward east.
Pavements	· Concrete pavement sections are considered. · Traffic count data obtained from traffic count map website by Texas Department Transportation (TxDOT) were used in the pavement section calculations. · A truck traffic of 4 percent of average daily traffic (ADT) was assumed. · The pavement design period is 30 years per Collin County Roadway Standards.

GEOTECHNICAL CHARACTERIZATION

Geology

Geologically, the west and east portions of the alignment are situated on the outcrop of Austin Chalk and Ozan formations of Cretaceous Age, respectively.

The primary rock of the Austin Chalk is a chalky limestone with interbedded marl. In full section, the Austin Chalk is several hundred feet thick and dips to the southeast approximately 2 degrees.

Locally the Austin Chalk may be divided into three parts. The upper part contains more limestone than marl. The middle is composed of weaker limestone with thick beds of marl, and the lower part consists of massive limestone with thin shale partings. The site is on the upper member.

Faulting has occurred in the formation. The faults are no longer considered active. Displacements are normally less than 5 feet, but can exceed 30 feet. The Austin Chalk is not water bearing; however, groundwater often is found in the fracture zones associated with faults.

The Ozan formation consists of primarily calcareous clays with thin limestone lenses in lower part of the formation. The clays are calcareous with silt and sand contents and blocky.

Subsurface Conditions

We have developed a general characterization of the subsurface conditions based upon our review of the borings, laboratory data, and geologic setting. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options.

Conditions encountered at each boring location are indicated on the boring logs. The boring logs can be found in the **Exploration Results** section and the GeoModel that shows borings side by side can be found in the **Figures** section of this report.

Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual. It should be noted that subsurface conditions were evaluated by drilling 11 borings and variations in subsurface conditions may be present away from these borings.

As part of our analyses, we selected the following GeoModel layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fill**	Fat clay, lean clay or clayey sand fill
2	**Fat Clay**	Dark brown, gray, brown, and tan highly expansive fat clay (CH)
3	**Lean Clay/ Clayey Sand**	Tan and light gray, brown moderately expansive lean clay with sand (CL) or dark brown and gray clayey sand (SC)
4	**Limestone**	Tan or tan and gray weathered limestone

The encountered clay fills and natural clays are considered to be highly expansive and will swell with increases in moisture content and shrink with loss of moisture. Using anticipated design overburden pressures, absorption free swell tests were performed on selected clay samples. Free swell values of about 0.4 to 1.6 percent were measured, indicating that the on-site soils are in a relatively moist condition at the time of our filed exploration.

Boring Drilled by Others

Three borings were drilled by ECS Southwest LLP in November 2018 and five borings were drilled by D&S Engineering in November 2016. Logs of these borings were provided to us by the client. These borings are also considered in our geotechnical characterization. Those borings are presented in the **Borings Drilled by Others** section.

Groundwater Conditions

The borings were advanced using dry auger drilling techniques which allows short-term groundwater observations to be made while drilling. Water level observations in borings were made during and upon on completion of drilling. Water was not observed in the borings during and upon on completion of drilling. Groundwater observations are provided in the boring logs in **Exploration Results**.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the construction plans for the project.

Double-Ring Infiltrometer

Two double-ring infiltrometer tests were performed in the field at the locations shown on **Exploration Plan**. The test results are presented in **Exploration Testing and Procedures** section. Water infiltration was not observed at the selected test locations for the tested duration due to low permeability of the onsite soils.

GEOTECHNICAL OVERVIEW

Expansive clay fills and clays are present at this site. These soils are capable of considerable volume change with variations in moisture level. The magnitude of the moisture induced potential vertical rise (PVR) at this site is dependent on several factors including the thickness of active clay fills and clays, and moisture levels at the time of construction. We estimate that the PVR be about 5 inches, based on Tex-124-E method, for pavements when the soils are in a dry moisture state.

Portland cement concrete (PCC) pavement is recommended for this roadway. Concrete pavement is recommended to be placed on lime stabilization subgrade. A minimum of 9 percent of lime is recommended.

Pavement construction and pavement subgrade preparations should be in accordance with North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards and City of Lucas Construction standards/practices. TXDOT Standard Specifications for Construction and Maintenance of Highways, Street and Bridges published in 2014 shall be followed in the absence of NCTCOG standards or City of Lucas Construction standards/practices.

Geotechnical recommendations for earthwork and pavement are presented in the following report sections. The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for pavements.

Site Preparation

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the pavement widening areas.

The subgrade should be proof-rolled with an adequately loaded vehicle. Proof rolling should be performed following guidelines presented in NCTCOG Item 301.1.1.3.4 *Proof Rolling*. A minimum gross weight of 20 tons is recommended for the proof rolling equipment. The proof-rolling should be performed under the direction of the Geotechnical Engineer and/or the City of Lucas representative. Where excavations are involved, proof rolling should be performed after excavating to the final grade. The proof rolling should consist of several overlapping passes over a given area as stated in NCTCOG Item 301.1.1.3.4.

Areas excessively deflecting under the proof-roll should be excavated to firm ground. Excavated areas should be backfilled with properly placed and compacted fill as discussed in section **Fill Materials Types**. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

Existing Fill

As noted in **Geotechnical Characterization**, borings TRCN B-2, TRCN B-3, TRCN B-4, TRCN B-5, TRCN B-7, TRCN B-9, and TRCN B-11 encountered existing fill to depths ranging about 2.0 to 4.0 feet. The fill appears to have been placed in a controlled manner, but we have no records to indicate the degree of control. Support of pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, there is an inherent

risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered.

When the documentation of controlled fill placement is not available, removal of those fills and replacing them in a controlled manner is the most positive method of ensuring uniform fill placement and compaction beneath pavements. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report. Based on the limited test results performed on fill soils, these fills appeared to be in stiff state for pavement construction, provided pavement subgrade is prepared as described in **Site Preparation** section.
In pavement areas with existing fills, proof rolling, as described in section **Site Preparation**, can be considered in lieu of complete removal of the fill, if some risk can be taken. Proof rolling is intended to represent a reasonable approach for construction of the site grading and paving; it will not eliminate the risk of unexpected movements in some areas.

Fill Material Types

Fill materials should meet the following material property requirements. Fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Item	Technical Description	Appropriate Use
On-site soils	Free of vegetation and root mats	■ General site grading ■ Pavement subgrade
Imported fill	Clean clayey and/or sandy soils (free of deleterious material, debris and hazardous contaminants) with liquid limits (LL) less than 60 and Plasticity Index equal to or less than 35, and no rock greater than 4 inches in maximum dimension	
Flexible Base	NCTCOG Item 301.5	■ Pavement subgrade
Lime Stabilized Subgrade	NCTCOG Item 301.2 Minimum lime content of 9 percent is recommended.	■ Pavement subgrade

Fill Compaction Requirements

Recommendations for compaction are presented in the following table. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test must be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Type of Fill	Compaction Criteria
Subgrade preparation to receive fill	Surface scarified to a minimum depth of 6 inches and compacted to criteria below.
Lift thickness for all types of fill	Loose lift thickness of 8 inches or less.
General site fill	A minimum of 95% maximum standard Proctor dry density (ASTM D 698) in the range of 0 to +4 percentage points of optimum moisture content..
Pavement subgrades (natural or clay fills)	A minimum of 95% maximum standard Proctor dry density (ASTM D 698) in the range of 0 to +4 percentage points of optimum moisture content.
Lime Stabilized Soils	A minimum of 95% maximum standard Proctor dry density (ASTM D 698) in the range of -2 to +4 percentage points of optimum moisture content.

Utility Trench Backfill

Utility trenches are recommended to be backfilled in accordance with the City of Lucas requirements and/or NCTCOG standards.

Utility lines will be placed in backfilled trenches surrounded by expansive clays capable of moving up to 5 inches cyclically throughout the year. This level of movement can lead to bending, cracking, or separation of utility connections. Utility trenches should be backfilled with on-site soils.

Earthwork Construction Considerations

It is anticipated that excavations in the overburden soils for the proposed construction can be accomplished with conventional earthmoving equipment within clay strata. Subgrade soils exposed during construction are anticipated to be relatively stable for general construction traffic. However, the stability of the subgrade may be affected by rain, repetitive construction traffic, depth to the groundwater, if encountered during construction, or other factors. If unstable conditions develop, workability may be improved by scarifying and drying.

Upon completion of filling and grading, care should be taken to maintain the clay subgrade moisture content prior to construction of pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to pavement construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards (OSHA Standards 29 CFR-1926, Appendices A and B).

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling, and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least three tests for every 300 longitudinal feet of the roadway in pavement areas or as specified by the City of Lucas. One density and water content test for every 50 linear feet of compacted utility trench backfill or as specified by the City of Lucas.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

PAVEMENT RECOMMENDATIONS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Information** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Site Preparation** section and in the following sections of this report.

Portland cement concrete pavements are recommended for this roadway. Traffic data for this roadway is not available at the time of the report. Traffic count data obtained from traffic count map website by TxDOT were used in the pavement section calculations.
Highly expansive clays were encountered in the borings. Pavement subgrade modification to reduce Potential Vertical Rise (PVR) is not considered for this roadway due to anticipated low traffic volume and low posted speed limits.

Support characteristics of subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

Potential Vertical Rise

Clays with high shrink/swell potential were encountered in all borings. These soils are prone to volume changes with variations in moisture level.

The existing pavement subgrade was analyzed for a 15 foot seasonal moisture variation depth. Calculations were performed to estimate the potential vertical rise (PVR) of the pavement. The PVR calculations were performed based on TxDOT method Tex-124-E (Potential Vertical Rise). Potential Vertical Rise (PVR) results for a 15 foot seasonal active moisture zone are presented in the table below for each boring. The PVR calculations are presented in **Pavement Calculations and Traffic Data** section. The PVR calculations were based on dry moisture conditions.

EXPECTED PVR ALONG WEST LUCAS ROAD ALIGNMENT		
Boring	**Plasticity Indices**	**Expected PVR (inches)**
TRCN B-1	23 to 46	2.2
TRCN B-2	14 to 62	3.6

EXPECTED PVR ALONG WEST LUCAS ROAD ALIGNMENT		
Boring	**Plasticity Indices**	**Expected PVR (inches)**
TRCN B-3	15 to 54	3.8
TRCN B-4	21 to 60	4.8
TRCN B-5	40 to 64	4.1
TRCN B-6	21 to 51	3.9
TRCN B-7	42 to 55	5.0
TRCN B-8	47	2.7
TRCN B-9	23 to 56	4.5
TRCN B-10	49 to 51	2.5
TRCN B-11	38 to 44	3.9

Potential Vertical Rise – Swell Test Method

Swell tests were performed on selected samples obtained from Borings TRCN B-1 through TRCN B-11. The average swell at each boring is presented in the following table. The estimated PVR values provided below are calculated considering the average swell over a depth of 15 feet or soil strata thickness to the top of limestone. The results of the swell tests are tabulated in **Exploration Testing and Procedures** section.

ESTIMATED PVR USING SWELL TESTS		
Boring Number	**Average Swell (%)**	**Estimated Potential Vertical Rise (inches)**
TRCN B-1	1.3	0.9
TRCN B-2	0.4	0.6
TRCN B-3	0.2	0.3
TRCN B-4	1.1	1.5
TRCN B-5	1.2	1.3

ESTIMATED PVR USING SWELL TESTS		
Boring Number	**Average Swell (%)**	**Estimated Potential Vertical Rise (inches)**
TRCN B-7	0.5	1.1
TRCN B-8	1.0	0.8
TRCN B-9	0.5	0.7
TRCN B-10	0.5	0.7
TRCN B-11	1.0	1.5

Based on the swell test results, the estimated PVR ranges from about 0.3 to 1.5 inches, indicating that the on-site soils are in a relatively moist condition at the time of our filed exploration.

Soluble Sulfate Tests

Soluble sulfates tests were performed on selected samples obtained in the borings. These laboratory test results are presented in **Exploration Testing and Procedures** section. Soluble sulfate concentrations in the tested samples varied between 0 and 2,093 PPM (Particles per Million), except one test result of 3,520 PPM at about 1.2 to 2 feet in TRCN B-8.

It should be noted that soluble sulfate concentrations provided above are from the limited laboratory tests performed on the selected number of samples. We recommend performing a soluble sulfate testing program once the new pavement subgrade is rough graded to proposed pavement grades during construction.

Based on the TxDOT Manual “Guidelines for treatment of Sulfate-Rich Soils and Bases in Pavement Structures” September 2005, the soluble sulfates tests indicate the pavement subgrade consisting onsite clays is suitable for lime stabilization.

Lime Stabilized Soils

Lime stabilization series tests were performed on bulk samples retrieved at the site. The optimum lime addition percentage was determined in accordance with TxDOT test method Tex-112-E Atterberg Limits Soil-Lime series. Soil PI- Lime series test results are presented in **Exploration Testing and Procedures** section. Based on the soil PI-lime series results, the optimum lime content is 8 percent hydrated lime by dry weight. As stated in the Colin County Roadway Standards, we recommend adding one percent lime to the above optimum lime content to take into account the variations in lime application and mixing of the lime in the field. We recommend

a lime content of 9 percent hydrated lime, by dry weight, for treating West Lucas Road pavement subgrade. The lime stabilization should be performed in accordance with NCTCOG Item 301.2 *Lime Treatment*.

New pavement subgrades may consist of new fills at some areas along West Lucas Road alignment. The lime contents should be confirmed by laboratory testing once the new pavement subgrade consisting of new fill is rough graded. The laboratory testing should include soil-lime testing using TxDOT test method Tex-112-E and soluble sulfate tests.

Pavement Subgrade Preparation

The pavements at the site are anticipated to be consisting of expansive clays. Concrete pavements placed on lime stabilized subgrade are recommended for this site.

The natural/lime stabilized subgrade subgrades should be uniformly compacted to the criteria described in section **Fill Compaction Requirements**. All pavement subgrades should be protected and maintained in a moist condition until the pavement is placed. Pavement subgrades should be graded to prevent ponding and infiltration of excessive moisture on or adjacent to the pavement subgrade surface.

Site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or excessive rutting. If disturbance has occurred, pavement subgrade areas should be reworked and properly compacted to the recommendations in this report immediately prior to paving.

Pavement Traffic

The traffic patterns and anticipated loading conditions were not available at the time of this report; Traffic count data obtained from the traffic count map website by TxDOT were used in the pavement section calculations. Annual average daily traffic (AADT) counts of 14,777 and 12,924 were reported for West Lucas Road between Angel Parkway and Country Club Road in Year 2019. An AADT of 14,777 was used in pavement section calculations. This AADT is presented in an exhibit in **Pavement Calculations and Traffic Data** section. A truck traffic count of 4% of AADT was assumed. TxDOT traffic data indicates traffic growths in the traffic counts between year 2013 and 2019. To take into account the future traffic growth on West Lucas Road, a growth factor of 2% was assumed for the design life traffic of the West Lucas Road pavement. Based on the available traffic and assumed information, calculated Equivalent 18k Single Axle Load (ESAL) for the design lane is 10,455,500 ESALs.

If the pavements are subject to heavier loading and higher traffic counts than the values used in the design, this office should be notified and provided with the information so that we may review these pavement sections and make revisions if necessary.

Permanent Pavement Section Recommendations

The pavements are recommended to be consisting of PCC sections. Lime stabilization is recommended for 8 inches of pavement subgrade. A design ESALs of 10,455,500, as described in **Pavement Traffic** section above, was used for the PCC section calculations.

The following table summarizes the design parameters used to calculate the PCC pavement sections.

PCC PAVEMENT DESIGN PARAMETERS	
Design Parameter	**Value**
Design Period	30 Year Period
AADT	14,777
Percent Trucks in AADT	4%
Directional Distribution	50%
Growth Factor	2%
Equivalent 18k Single Axle Load (ESAL) for Flexible Pavement	10,455,500
Compressive Strength of Concrete	4,000 psi
Concrete Modulus of Rupture	570 psi
Concrete Modulus of Elasticity	5,000,000 psi
Subgrade Resilient Modulus	6 ksi
Composite Modulus of Subgrade Reaction with 8-inch Lime Stabilized Subgrade	357.4 psi/in
Initial Serviceability	4.5
Final Serviceability	2.5
Reliability	90%

PCC PAVEMENT DESIGN PARAMETERS	
Design Parameter	**Value**
Standard Deviation	0.35

Based on hand penetrometer values, compressive strength test results, TxDOT pavement design manual, default subgrade resilient value from TxDOT FPS 21 program, and our experience with similar clay soils, a subgrade resilient modulus value of 6 ksi was considered for pavement subgrade along West Lucas Road alignment.

Pavement section calculations were performed based on the AASHTO Guide for Design of Pavement Structures. American Concrete Pavement Association's WinPAS Program was used to calculate the pavement section. The results of the pavement section calculations are presented in **Pavement Calculations and Traffic Data** section. The recommended pavement sections are presented in the following table.

COMPUTED PCC PAVEMENT SECTIONS FOR WEST LUCAS RD	
Pavement Layer	**Thickness for 30 Year Design (inches)**
PCC Concrete	10
Lime Stabilized Subgrade, NCTCOG Item 301.2	8
Total Pavement Structure Thickness	**18 inches**

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the base/subbase section. The pavement could be drained by a network of deep inlets and storm sewer system and in some areas by side ditches.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are

intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance may consist of crack and joint sealing and patching. Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%
- Subgrade and pavement surfaces should have a minimum 1% slope to promote proper surface drainage
- Install joint sealant and seal cracks immediately

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

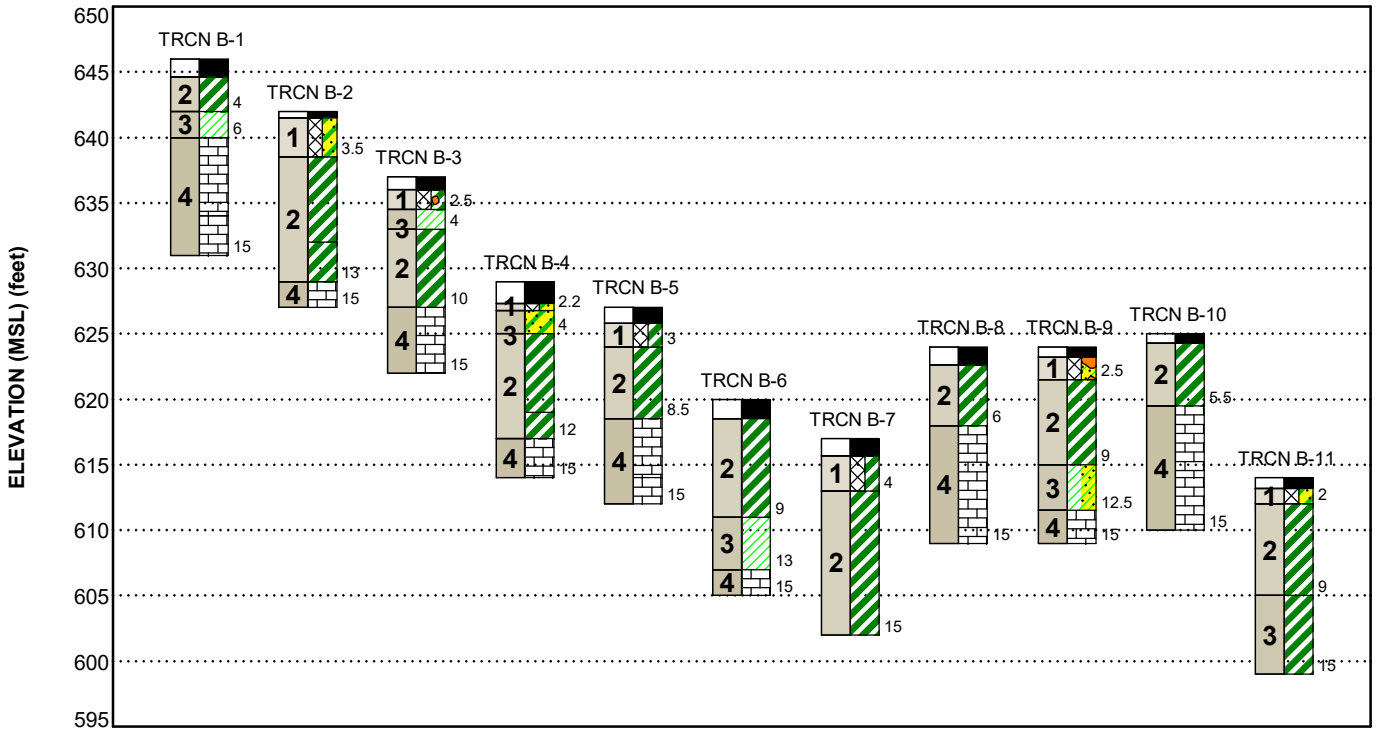
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

FIGURES

GEOMODEL

West Lucas Road Reconstruction and Widening ■ Lucas, Texas
Terracon Project No. 94215036



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Fill**	Fat clay, lean clay or clayey sand fill
2	**Fat Clay**	Dark brown, gray, brown, and tan highly expansive fat clay (CH)
3	**Lean Clay/ Clayey Sand**	Tan and light gray, brown moderately expansive lean clay with sand (CL) or dark brown and gray clayey sand (SC)
4	**Limestone**	Tan or tan and gray weathered limestone

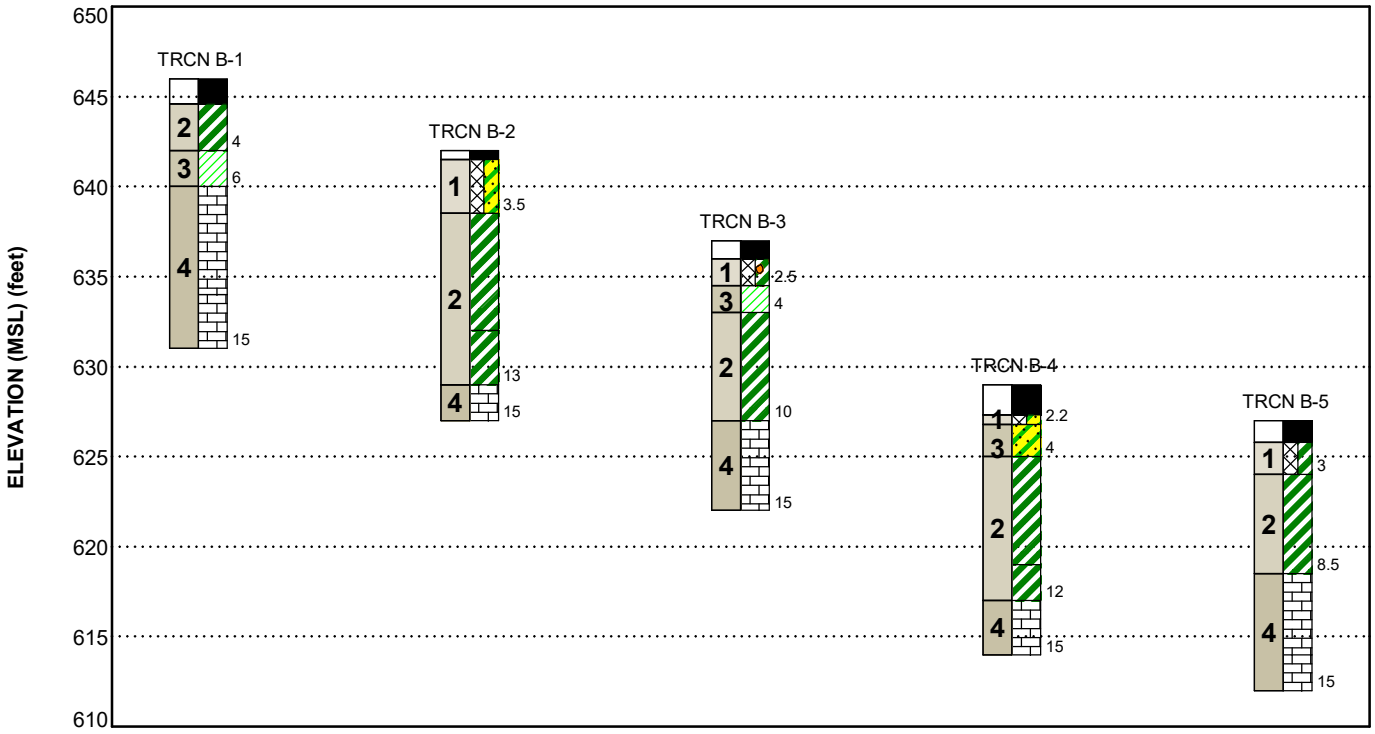
LEGEND

- Asphalt
- Fat Clay
- Lean Clay
- Highly Weathered Limestone
- Clayey Sand
- Fat Clay with Gravel
- Clayey Gravel with Sand
- Lean Clay with Sand

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL

West Lucas Road Reconstruction and Widening ■ Lucas, Texas
Terracon Project No. 94215036



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
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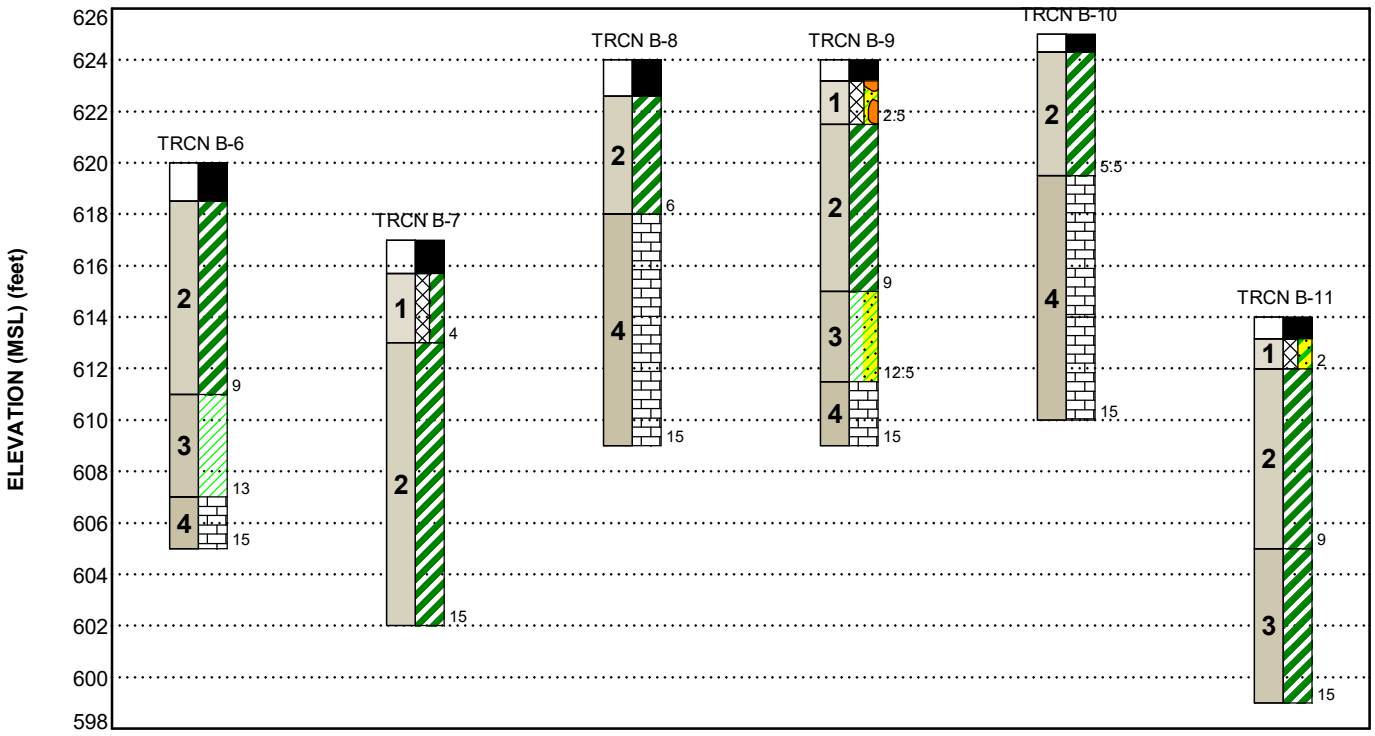
LEGEND

- Asphalt
- Fat Clay
- Lean Clay
- Highly Weathered Limestone
- Clayey Sand
- Fat Clay with Gravel

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL

West Lucas Road Reconstruction and Widening ■ Lucas, Texas
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4	**Limestone**	Tan or tan and gray weathered limestone

LEGEND

- Asphalt
- Fat Clay
- Lean Clay
- Highly Weathered Limestone
- Clayey Gravel with Sand
- Lean Clay with Sand
- Clayey Sand

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Location
11	15	Along West Lucas Road Alignment

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet. Approximate boring surface elevation were obtained from the Google Earth maps. The boring locations and elevations should be considered accurate only to the degree implied by the methods employed to determine them.

Subsurface Exploration Procedures: Approximate boring, bulk sample, and double-ring infiltrometer test locations are indicated on **Exploration Plan**. The field exploration was performed on April 19, 20 and May 20, 2021.

The borings were sampled using push tubes in clays. The load carrying capacity of the limestone was evaluated in the field using the Texas Department of Transportation's (TxDOT) Cone Penetration Test. The field exploration also included observations for groundwater while the borehole was being advanced and upon completion of drilling.

Two bulk samples were collected for Standard Proctor and California Bearing Ratio (CBR) tests. Two double-ring infiltrometer tests were performed in the field and those results are presented in this section.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepared field boring logs as part of the drilling operations. The boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on visual evaluation of the samples and laboratory test results. The boring logs are presented in **Exploration Results**. The Unified Soil Classification System (USCS) and description of rock properties are presented in **Supporting Information**.

Laboratory Testing

The samples and the field data were reviewed by a geotechnical engineer who selected soil samples for various laboratory tests to better understand the engineering properties of the subgrade materials. Laboratory tests were performed by technicians working under the direction of the engineer. A brief description of the tests performed follows.

Liquid and plastic limit tests and moisture content measurements were performed to aid in classifying the soils in accordance with the Unified Soil Classification System (USCS). Absorption swell tests were performed on selected samples of the cohesive material. These tests were used to quantitatively evaluate volume change potential at in-situ moisture levels. Strength and consistency of cohesive soils were measured by unconfined compressive strength and hand penetrometer tests.

Grain size analyses (without hydrometer) were performed on selected samples retrieved in the borings. Lime-PI series tests, Standard Proctor and CBR tests were performed on two bulk samples. The results of these tests are presented in this section.

Procedural standards noted below are for reference to methodology used in laboratory testing in general. In some cases, variations to methods were applied because of local practice or professional judgment.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- ASTM D4546 One-Dimensional Swell of Cohesive Soils
- ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
- ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D1883 Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
- TxDOT Standard Tex-145-E Determining Sulfate Content in Soils – Colorimetric Method
- TxDOT Standard Tex-112-E Admixing Lime to Reduce Plasticity Index of Soils

The results of the swell tests are presented in the following table. The results of the other laboratory tests are presented on the boring logs in **Exploration Results**.

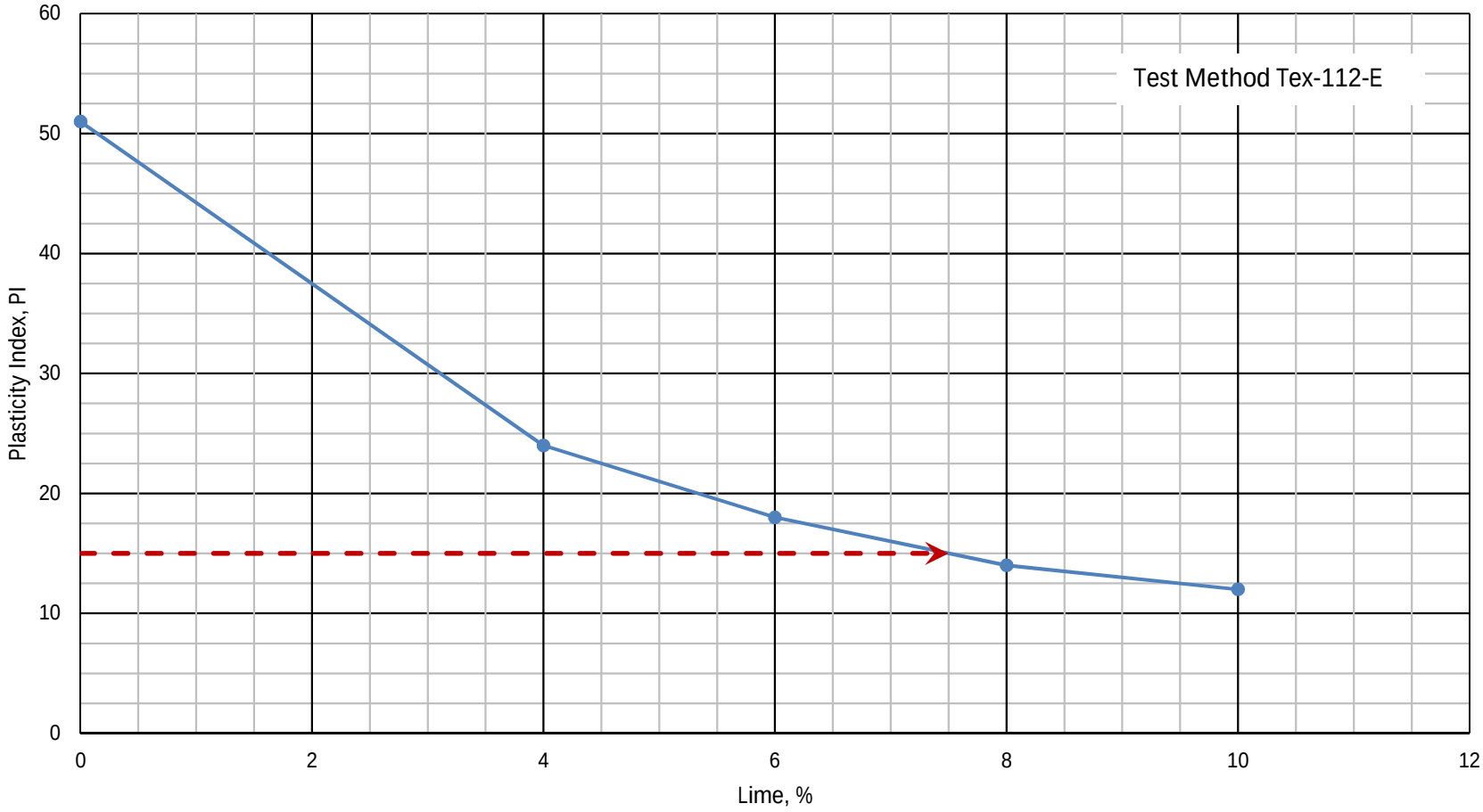
Boring No.	Depth (feet)	Liquid Limit (%)	Plasticity Index (%)	Initial Moisture (%)	Final Moisture (%)	Surcharge (psf)	Swell (%)
TRCN B-1	2 - 4	70	46	26.3	28.6	375	1.3
TRCN B-2	4 - 6	69	46	35.0	35.6	625	0.4

Boring No.	Depth (feet)	Liquid Limit (%)	Plasticity Index (%)	Initial Moisture (%)	Final Moisture (%)	Surcharge (psf)	Swell (%)
TRCN B-3	4 - 6	--	--	31.7	32.3	625	0.2
TRCN B-4	6 - 8	83	60	26.9	28.2	875	1.1
TRCN B-5	2 - 4	--	--	32.4	33.9	375	1.3
TRCN B-5	4 - 6	90	64	35.8	37.2	625	1.1
TRCN B-7	2 - 4	73	55	28.8	29.5	375	0.2
TRCN B-7	6 - 8	68	49	23.0	24.1	875	0.8
TRCN B-8	2 - 4	70	47	27.6	29.1	375	1.0
TRCN B-9	4 - 6	82	56	33.9	34.8	625	0.5
TRCN B-10	2 - 3	73	51	31.0	32.9	375	1.1
TRCN B-11	4 - 6	64	44	25.9	26.5	625	0.1
TRCN B-11	9 - 10	--	--	24.0	26.8	1125	1.6

Soluble sulfate tests were performed on selected soil samples. The soluble sulfate test results are presented in the following table:

Boring No.	Depth (feet)	Soluble Sulfate Content (mg/kg/ppm)
TRCN B-1	2 - 4	442
TRCN B-2	0.5 - 2	2,069
TRCN B-2	4 - 6	1,337
TRCN B-3	1 - 2	< 40
TRCN B-3	2.5 - 4	260
TRCN B-4	2 - 4	597
TRCN B-4	4 - 6	275
TRCN B-5	1.2 - 2	580
TRCN B-5	3 - 4	140
TRCN B-6	2 - 4	80
TRCN B-7	2 - 4	351

Boring No.	Depth (feet)	Soluble Sulfate Content (mg/kg/ppm)
TRCN B-7	4 - 6	55
TRCN B-8	1.4 - 2	3,520
TRCN B-8	2 - 3	336
TRCN B-9	1 - 2	< 20
TRCN B-9	2.5 - 4	0
TRCN B-10	0.7 - 2	511
TRCN B-10	1 - 2	1,516
TRCN B-10	3 - 4	305
TRCN B-11	2 - 4	365



Location: Bulk B-5
Depth : 0 - 5 feet

Recommended Lime, %	8

Project Mgr:	PT
Tested by:	PT
Checked by:	SPP
Approved by:	SPP

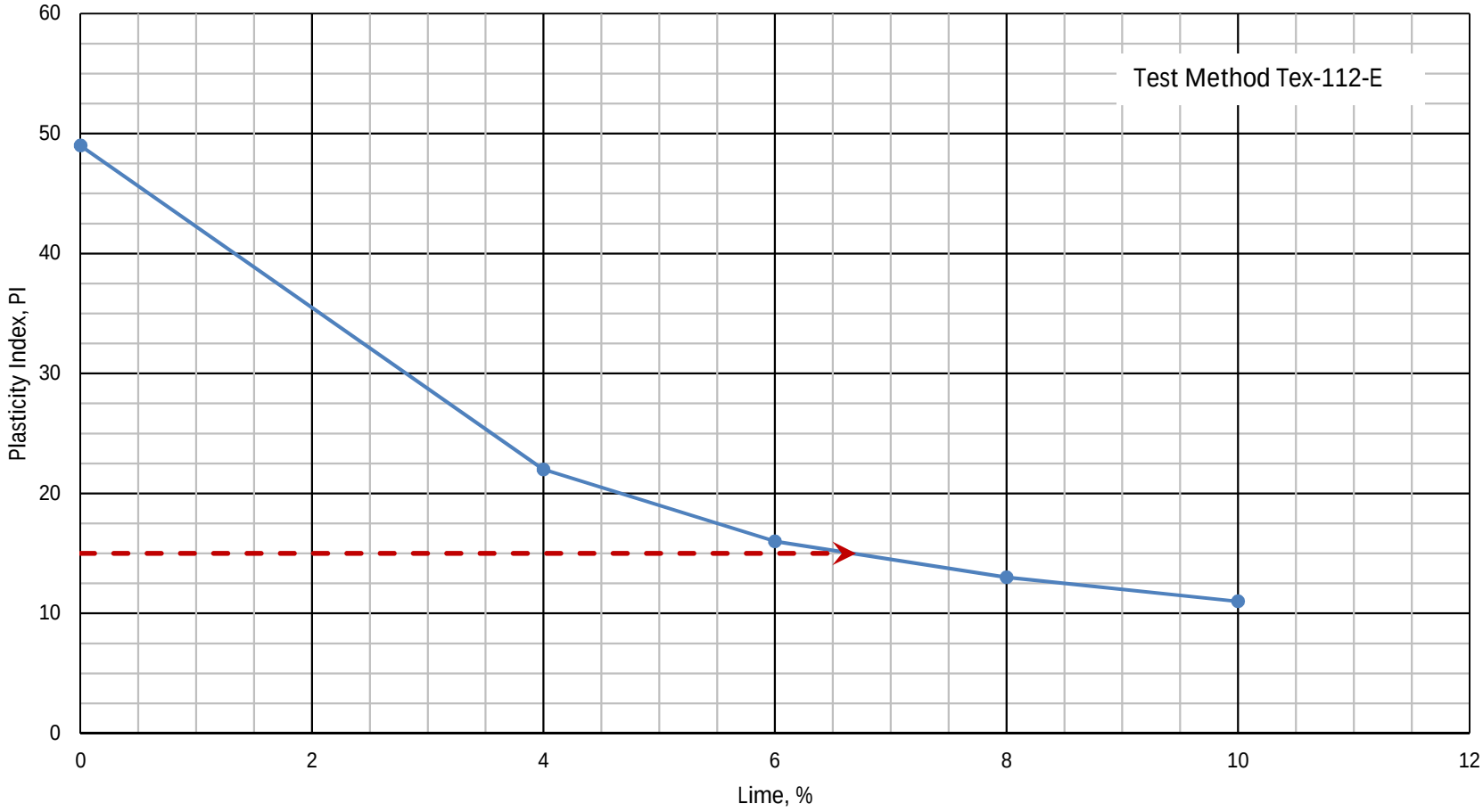
Project No.	94215036
Scale:	N/A
Date:	6/18/2021

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PH: (817) 268-8600 Fax. (817) 268-8602

LIME - PI TEST RESULTS

West Lucas Road Reconstruction and Widening

Lucas, Texas



Location: Bulk B-11
Depth : 0 - 5 feet

Recommended Lime, %	7

Project Mgr:	PT
Tested by:	PT
Checked by:	SPP
Approved by:	SPP

Project No.	94215036
Scale:	N/A
Date:	6/18/2021

Terracon
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2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118
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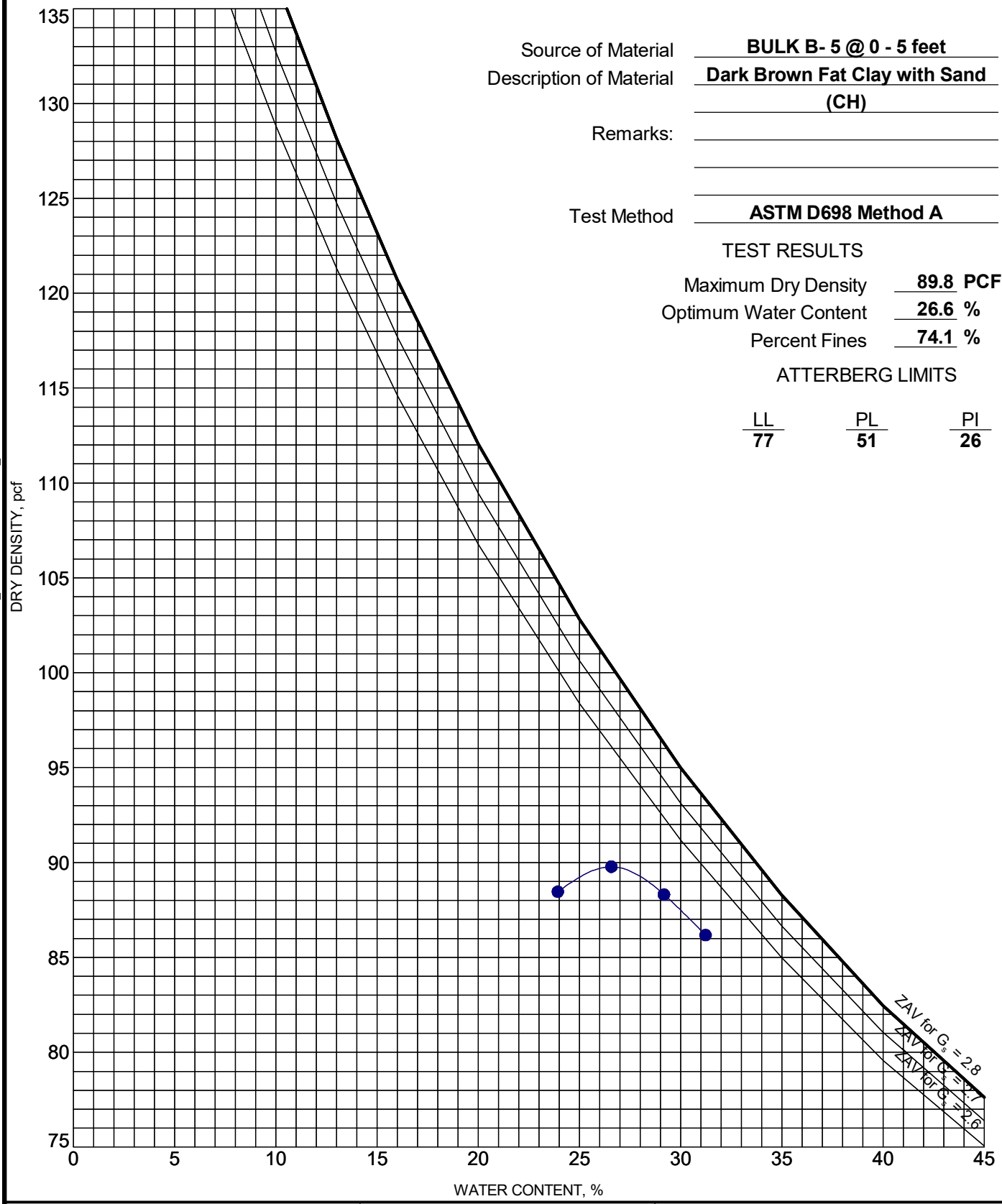
LIME - PI TEST RESULTS

West Lucas Road Reconstruction and Widening

Lucas, Texas

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**BULK B- 5 @ 0 - 5 feet**
Description of Material	**Dark Brown Fat Clay with Sand (CH)**
Remarks:	
Test Method	**ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**89.8**	**PCF**
Optimum Water Content	**26.6**	**%**
Percent Fines	**74.1**	**%**

ATTERBERG LIMITS

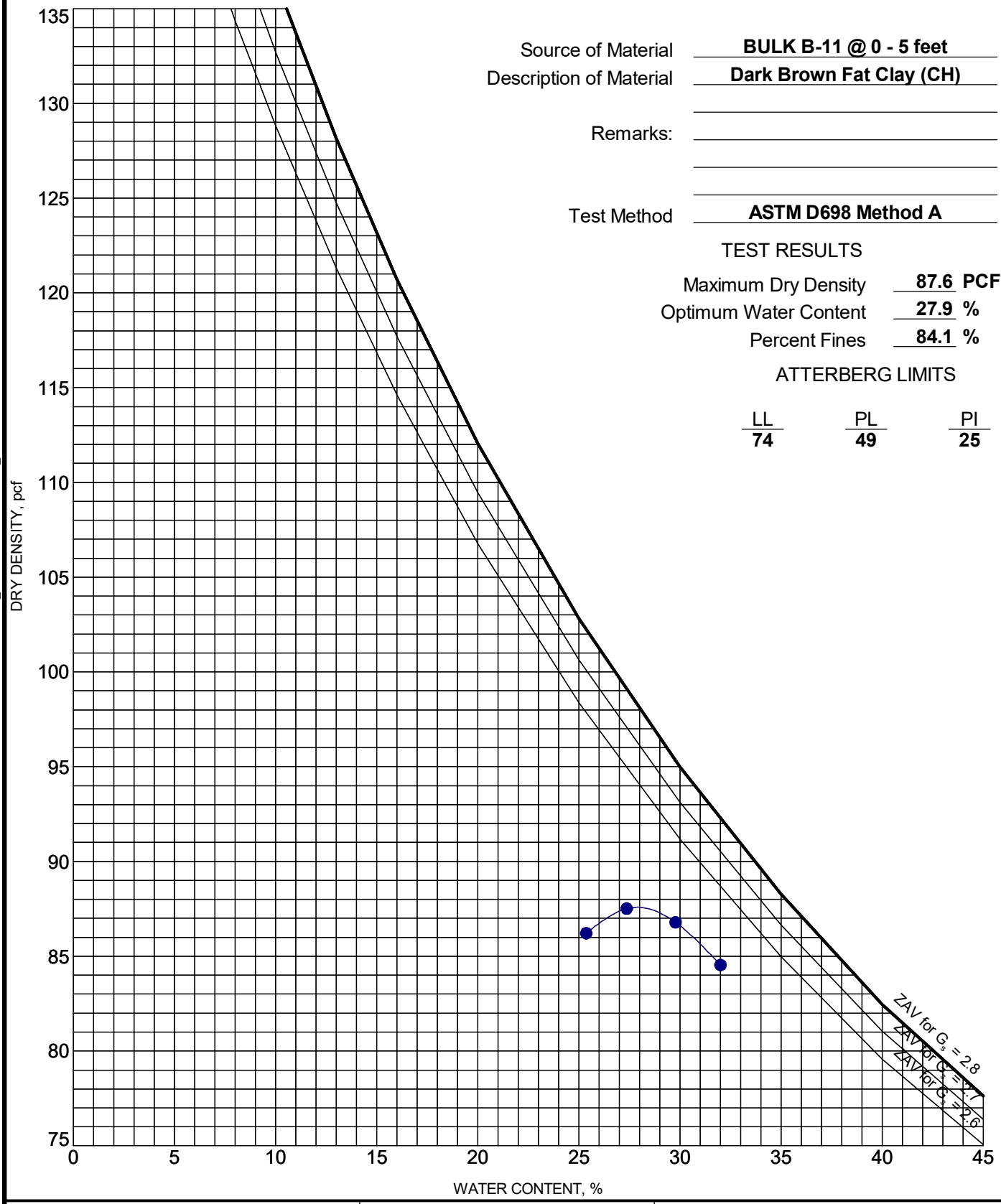
LL	PL	PI
77	**51**	**26**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 94215036 WEST LUCAS ROAD_BULK.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

PROJECT: West Lucas Road Widening	Terracon 8901 Carpenter Fwy Ste 100 Dallas, TX	PROJECT NUMBER: 94215036
SITE: West Lucas Road Lucas, TX		CLIENT: BCC Engineering Inc. Bedford, TX
		EXHIBIT: B-1

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**BULK B-11 @ 0 - 5 feet**
Description of Material	**Dark Brown Fat Clay (CH)**
Remarks:	
Test Method	**ASTM D698 Method A**

TEST RESULTS

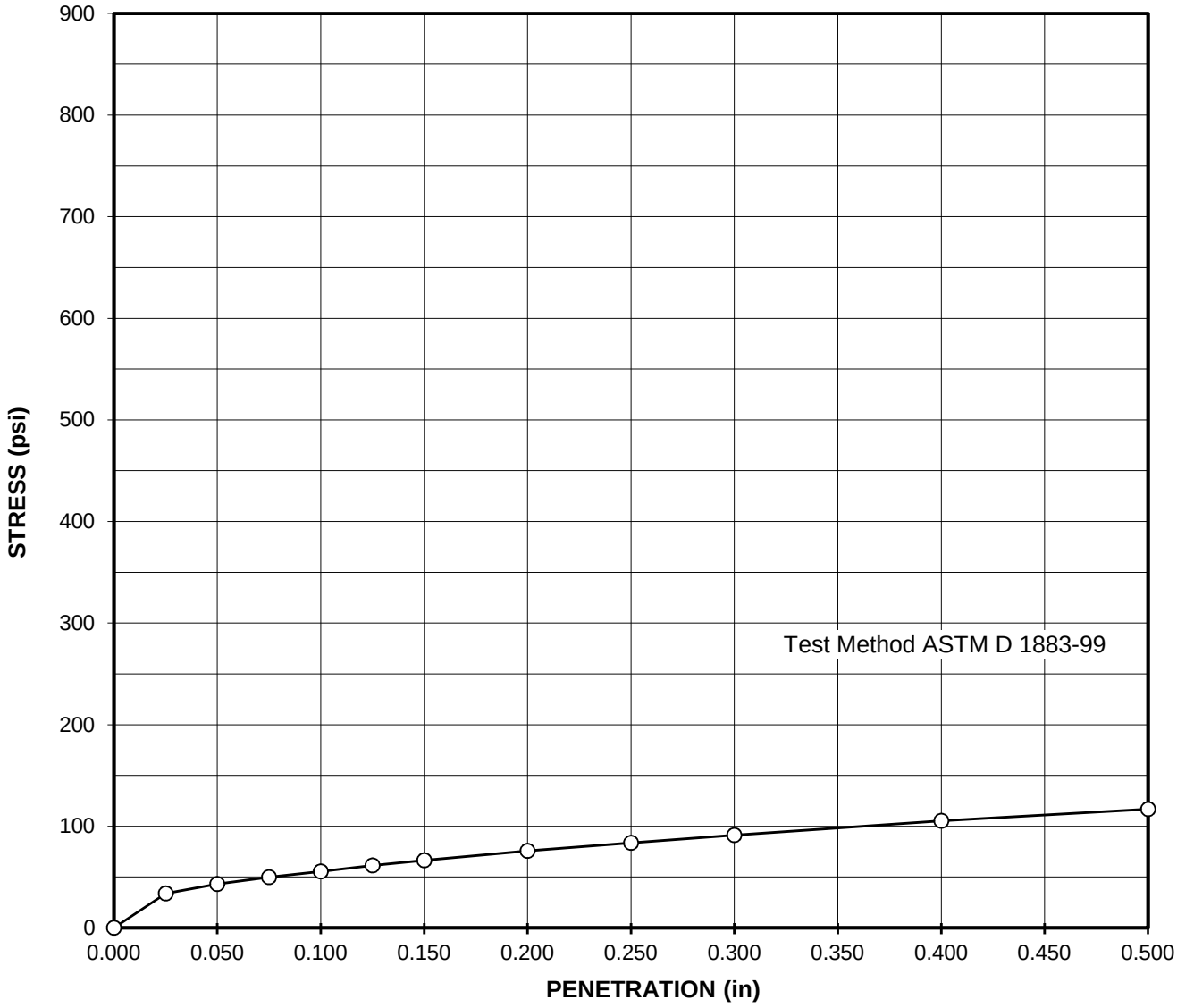
Maximum Dry Density	**87.6 PCF**
Optimum Water Content	**27.9 %**
Percent Fines	**84.1 %**

ATTERBERG LIMITS

LL	PL	PI
74	**49**	**25**

PROJECT: West Lucas Road Widening	Terracon 8901 Carpenter Fwy Ste 100 Dallas, TX	PROJECT NUMBER: 94215036
SITE: West Lucas Road Lucas, TX		CLIENT: BCC Engineering Inc. Bedford, TX
		EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 94215036 WEST LUCAS ROAD_BULK.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21



TEST INFORMATION

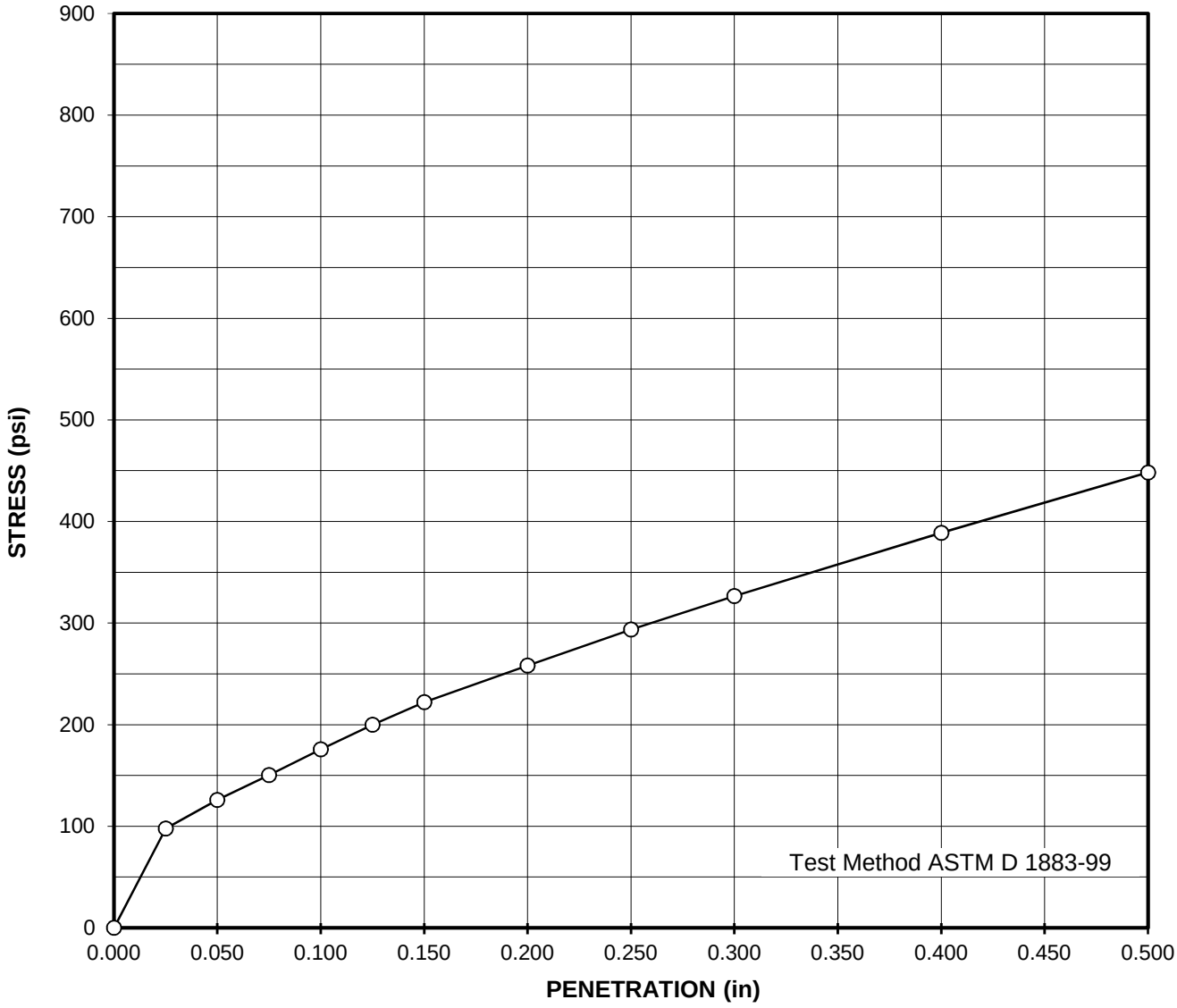
BORING: Bulk B-5
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 10 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	77
Plastic Limit:	26
Plasticity Index:	51
% Material Passing #200:	74.1

CBR RESULTS	
Maximum Dry Density:	89.8 pcf
Optimum Moisture Content:	26.6 %
Molded Dry Density:	75.7 pcf
Molding Moisture Content:	26.8 %
Moisture Content after test:	34.9 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	5.5

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **10 Blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

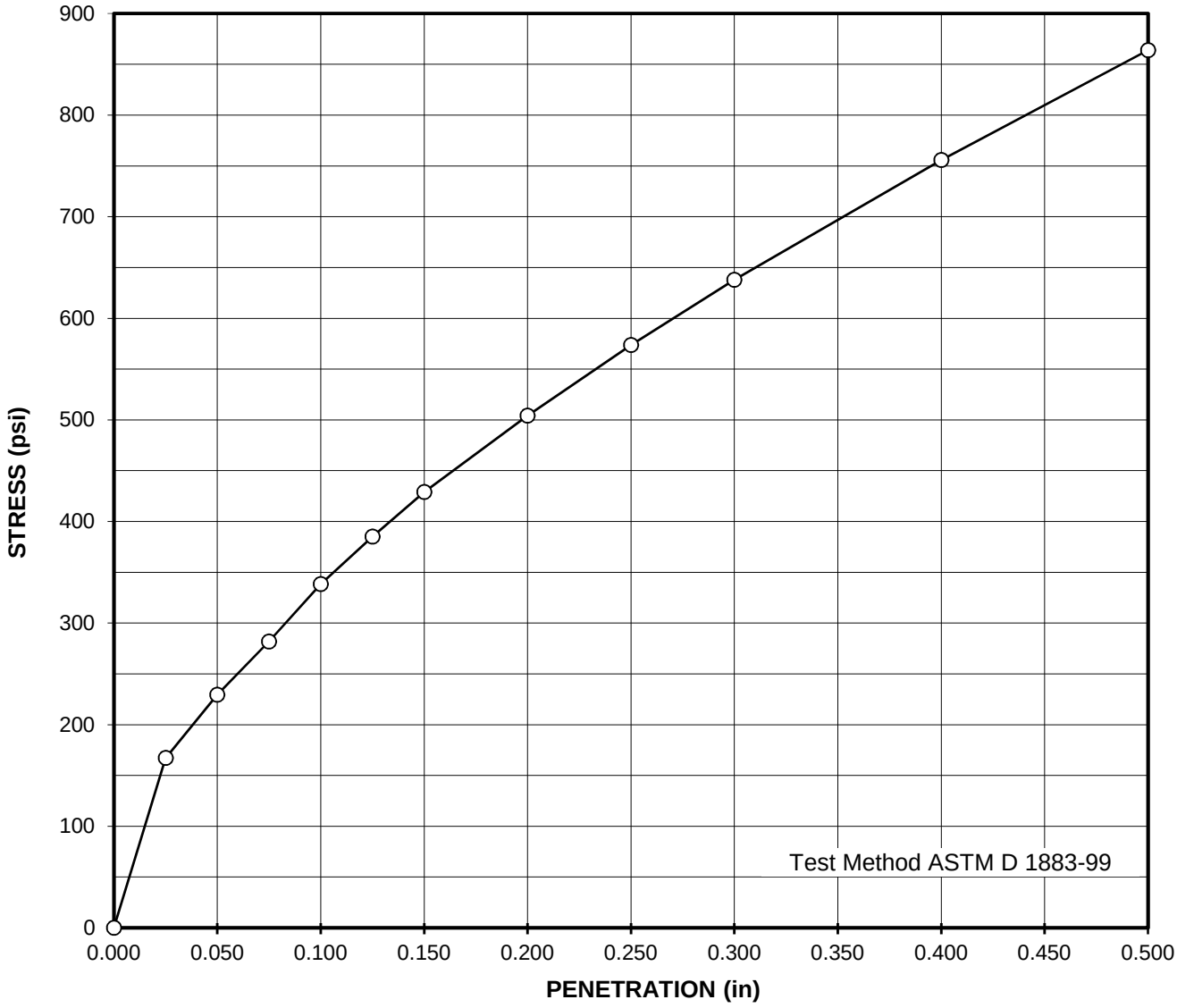
BORING: Bulk B-5
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 30 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	77
Plastic Limit:	26
Plasticity Index:	51
% Material Passing #200:	74.1

CBR RESULTS	
Maximum Dry Density:	89.8 pcf
Optimum Moisture Content:	26.6 %
Molded Dry Density:	85.3 pcf
Molding Moisture Content:	26.9 %
Moisture Content after test:	30.9 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	17.6

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **30 blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

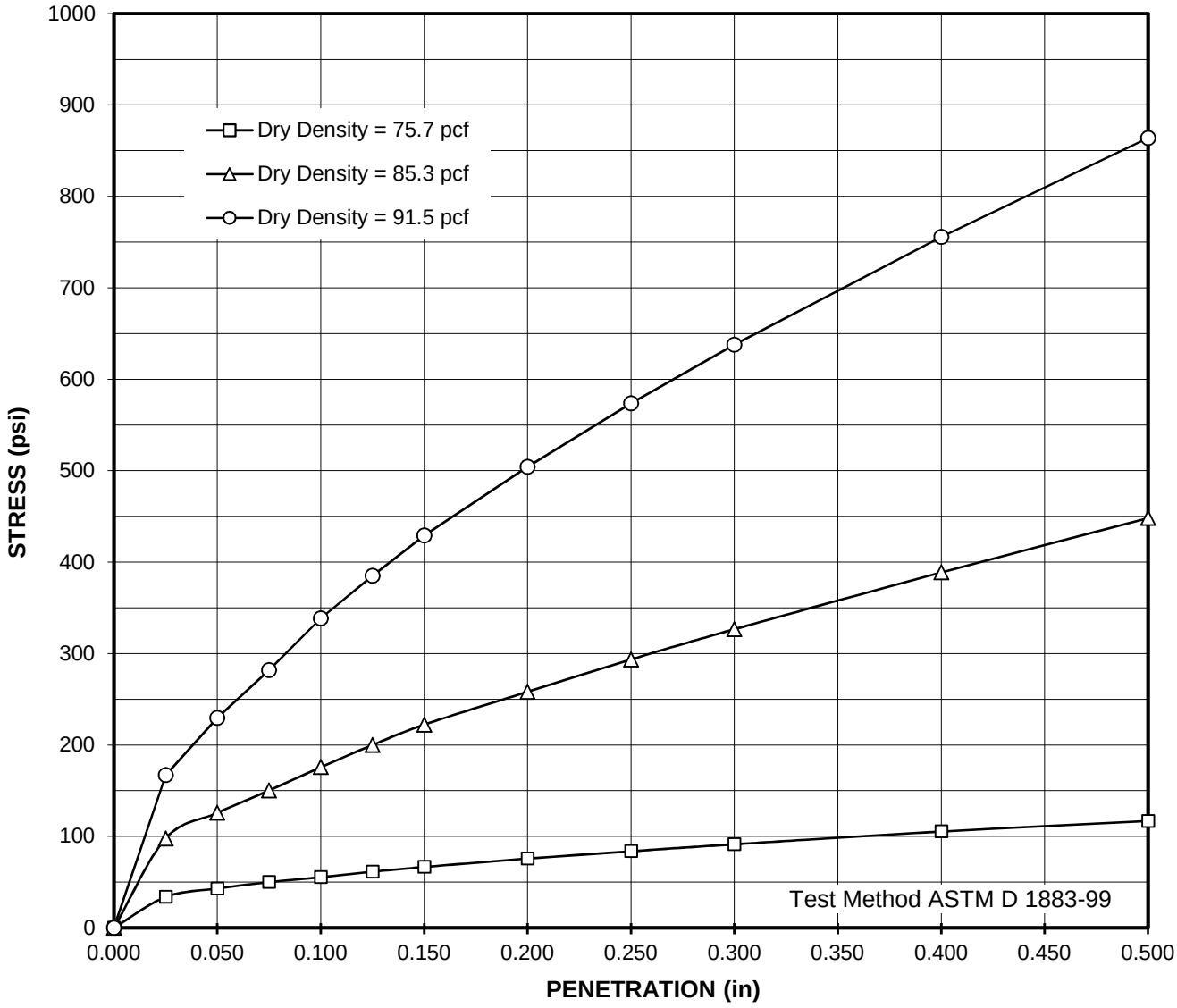
BORING: Bulk B-5
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 75 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	77
Plastic Limit:	26
Plasticity Index:	51
% Material Passing #200:	74.1

CBR RESULTS	
Maximum Dry Density:	89.8 pcf
Optimum Moisture Content:	26.6 %
Molded Dry Density:	91.5 pcf
Molding Moisture Content:	26.8 %
Moisture Content after test:	29.1 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	33.8

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **75 blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

BORING: Bulk B-5
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: Composite Curve
Surcharge Load: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	77	%
Plastic Limit:	26	%
Plasticity Index:	51	
% Material Passing #200:	74.1	%

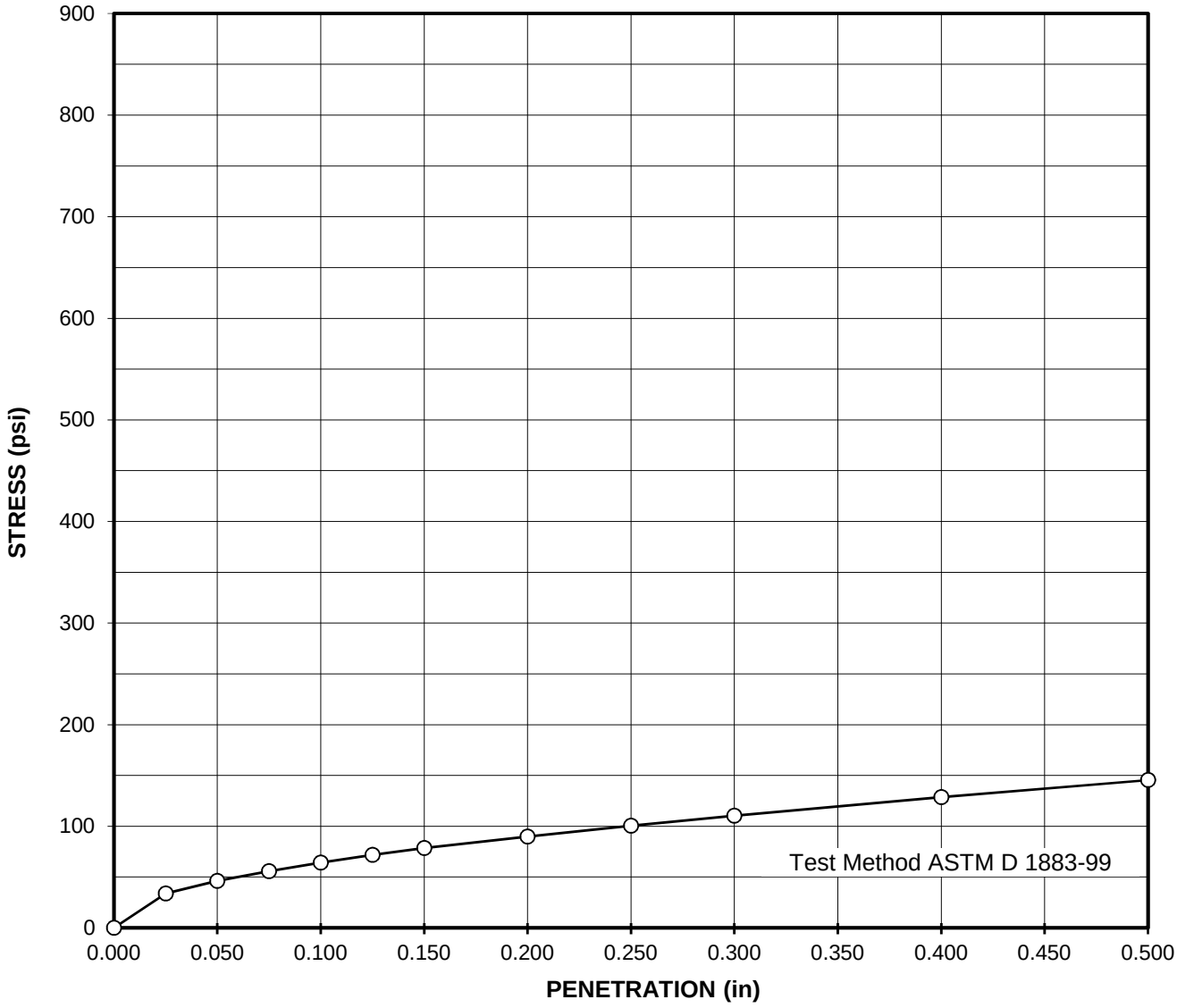
CBR RESULTS	
Sample molded at 75.7 pcf (dry density)	5.5
Sample molded at 85.3 pcf (dry density)	17.6
Sample molded at 91.5 pcf (dry density)	33.8
Estimated CBR for 95% of standard proctor dry density	17.6

Project Mgr:	CCP
Tested by:	CCP
Checked by:	TGA
Approved by:	TGA
Project No.	94215036
Scale:	N/A
Date:	4/12/2017

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Texas Registration 3272
2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118
PH: (817) 268-8600 Fax. (817) 268-8602

CBR TEST RESULTS
COMPOSITE RESULTS

West Lucas Rd Reconstruction and Widening
Lucas, Texas



TEST INFORMATION

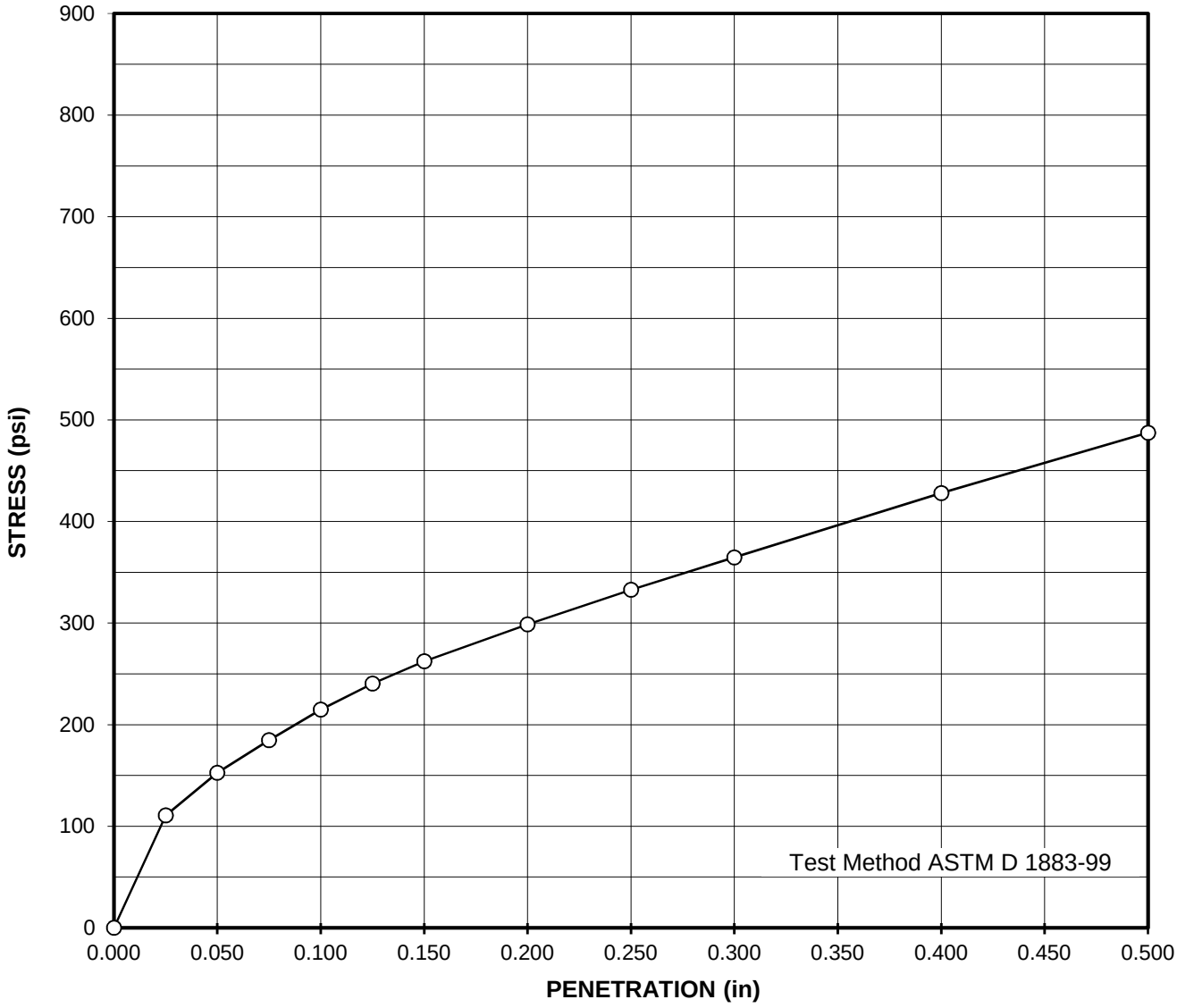
BORING: Bulk B-11
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 10 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	74
Plastic Limit:	25
Plasticity Index:	49
% Material Passing #200:	84.1

CBR RESULTS	
Maximum Dry Density:	87.6 pcf
Optimum Moisture Content:	27.9 %
Molded Dry Density:	75.6 pcf
Molding Moisture Content:	27.2 %
Moisture Content after test:	34.4 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	6.4

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **10 blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

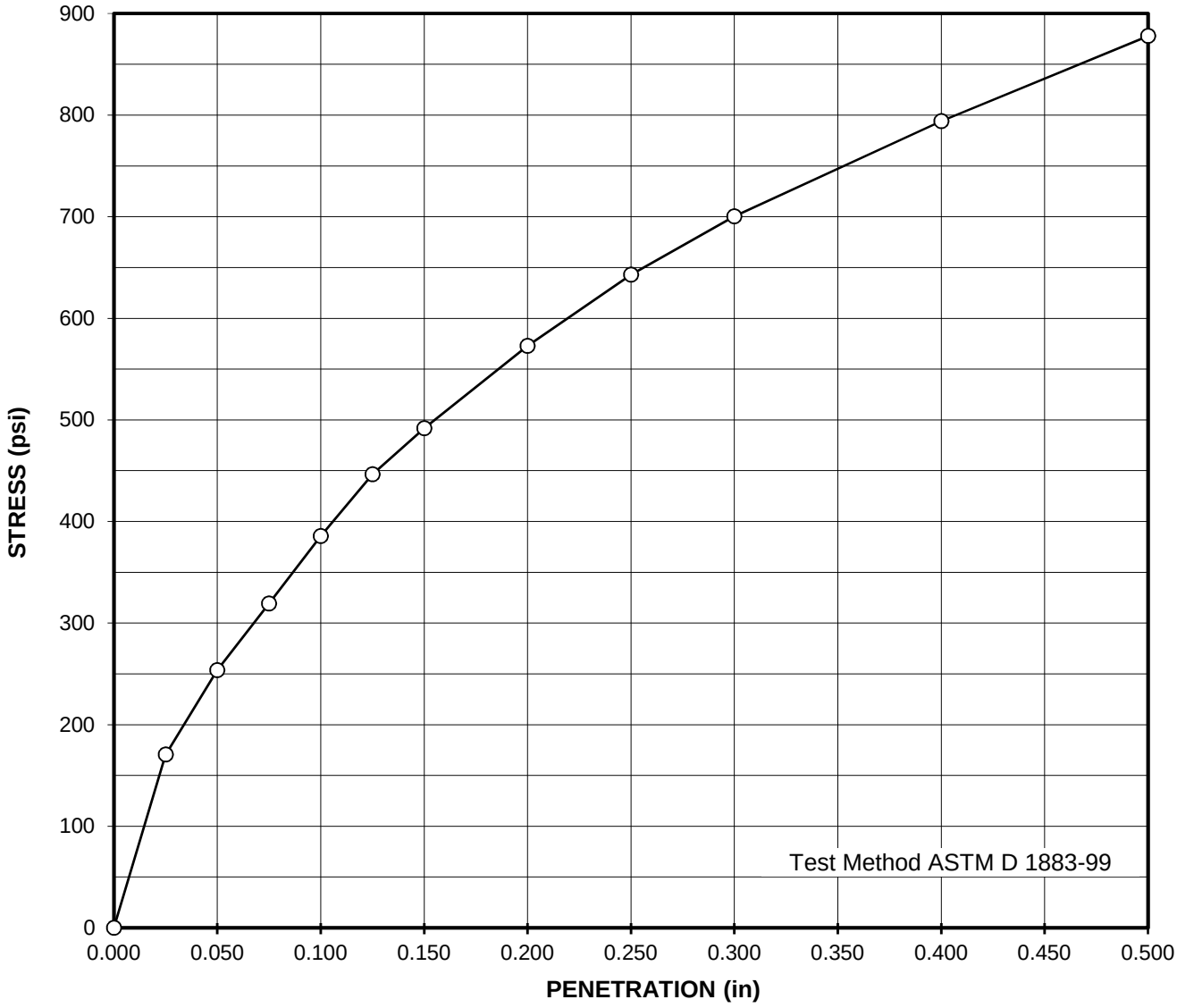
BORING: Bulk B-11
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 30 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	74
Plastic Limit:	25
Plasticity Index:	49
% Material Passing #200:	84.1

CBR RESULTS	
Maximum Dry Density:	87.6 pcf
Optimum Moisture Content:	27.9 %
Molded Dry Density:	85.1 pcf
Molding Moisture Content:	27.6 %
Moisture Content after test:	30.0 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	21.5

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **30 blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

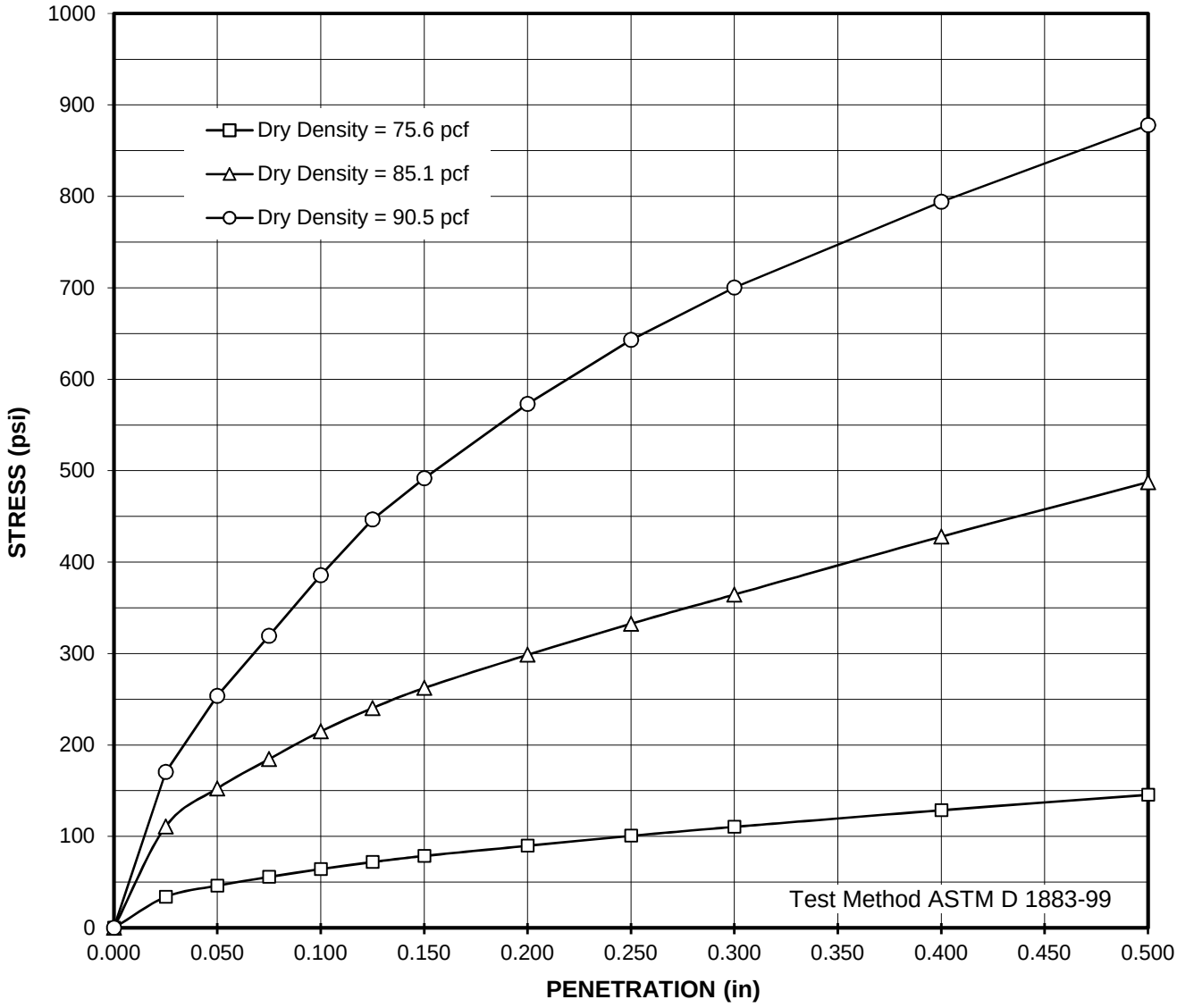
BORING: Bulk B-11
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: 75 blows
SURCHARGE LOAD: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	74
Plastic Limit:	25
Plasticity Index:	49
% Material Passing #200:	84.1

CBR RESULTS	
Maximum Dry Density:	87.6 pcf
Optimum Moisture Content:	27.9 %
Molded Dry Density:	90.5 pcf
Molding Moisture Content:	27.4 %
Moisture Content after test:	27.8 %
Swell:	0.0 %
Soaked CBR at 0.1 inch pen.:	38.6

Project Mgr:	Project No. 94215036	Terracon Consulting Engineers and Scientists Texas Registration 3272 2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118 PH: (817) 268-8600 Fax. (817) 268-8602	**CBR TEST RESULTS** **75 blows**
Tested by:			
Checked by:	Scale: N/A		West Lucas Rd Reconstruction and Widening Lucas, Texas
Approved by:	Date:		



TEST INFORMATION

BORING: Bulk B-11
DEPTH: 0-5'
SAMPLE DESCRIPTION: Dark Brown Clay with 9% Lime
TRIAL: Composite Curve
Surcharge Load: 10 lbs

LABORATORY PROPERTIES

Liquid Limit:	74	%
Plastic Limit:	25	%
Plasticity Index:	49	
% Material Passing #200:	84.1	%

CBR RESULTS	
Sample molded at 75.6 pcf (dry density)	6.4
Sample molded at 85.1 pcf (dry density)	21.5
Sample molded at 90.5 pcf (dry density)	38.6
Estimated CBR for 95% of standard proctor dry density	17.0

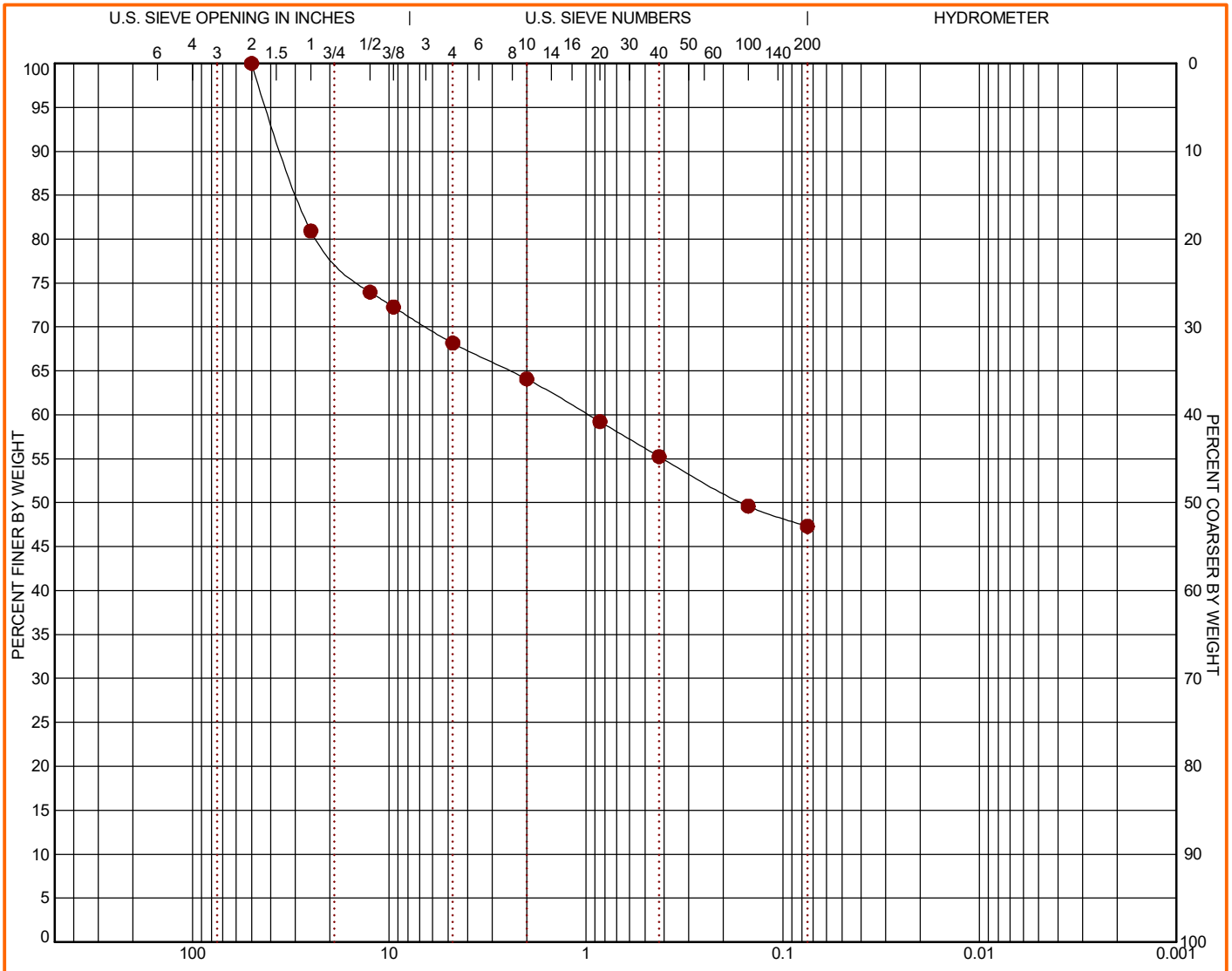
Project Mgr:	CCP
Tested by:	CCP
Checked by:	TGA
Approved by:	TGA
Project No.	94215036
Scale:	N/A
Date:	4/12/2017

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CBR TEST RESULTS
COMPOSITE RESULTS
West Lucas Rd Reconstruction and Widening
Lucas, Texas

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-2	2 - 3.5	0.0	31.8	20.9		47.3		

GRAIN SIZE			
	●		
D_{60}	0.974		
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●						
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer	
2"	100.0					
1"	80.93					
1/2"	73.96					
3/8"	72.27					
#4	68.17					
#10	64.09					
#20	59.23					
#40	55.25					
#100	49.61					
#200	47.32					

SOIL DESCRIPTION	
●	

REMARKS	
●	SS=2069.3ppm

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

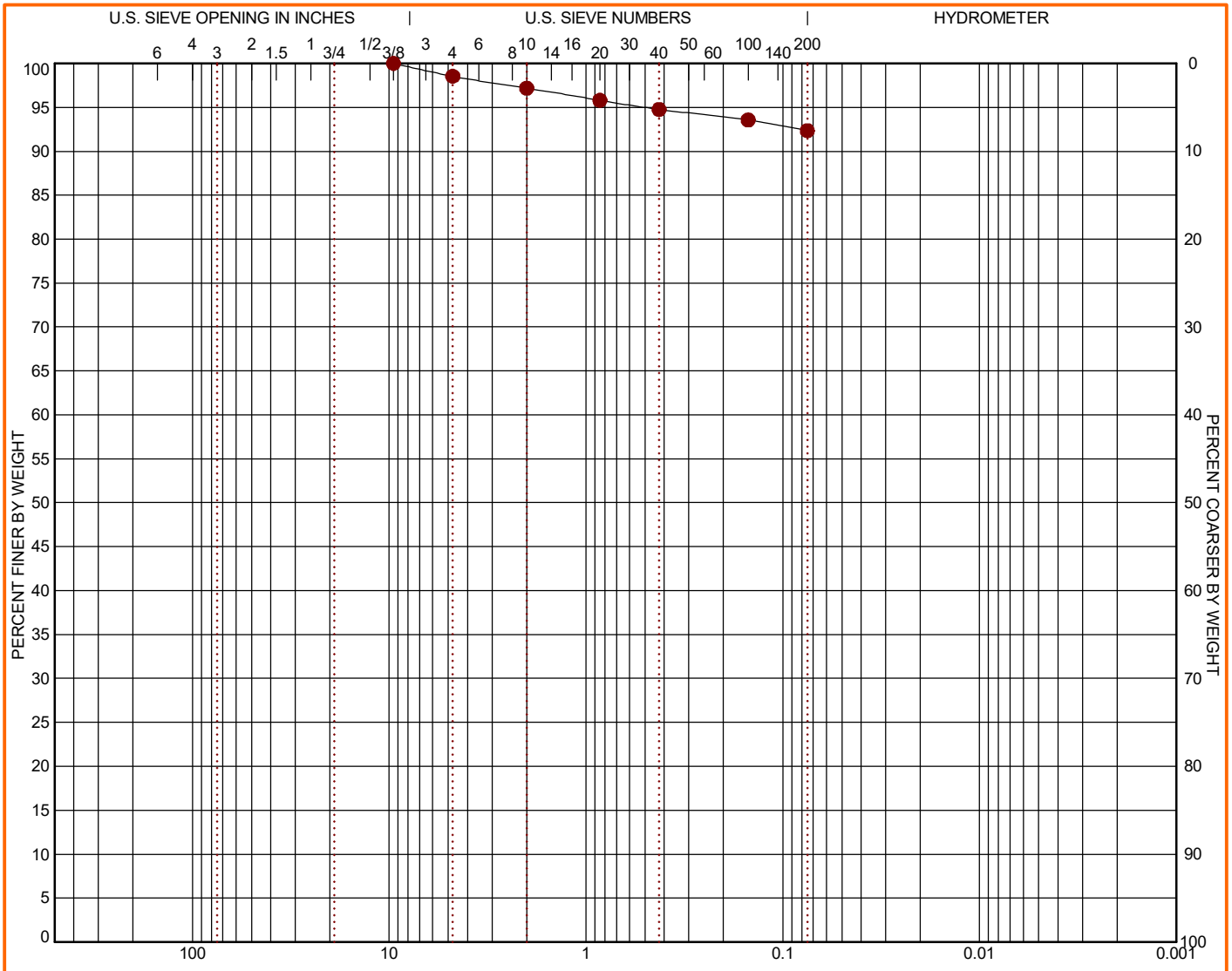
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-3	6 - 8	0.0	1.5	6.2		92.3		CH

GRAIN SIZE			
	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	98.54				
#10	97.18				
#20	95.8				
#40	94.76				
#100	93.56				
#200	92.34				

SOIL DESCRIPTION
● FAT CLAY (CH)

REMARKS
●

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

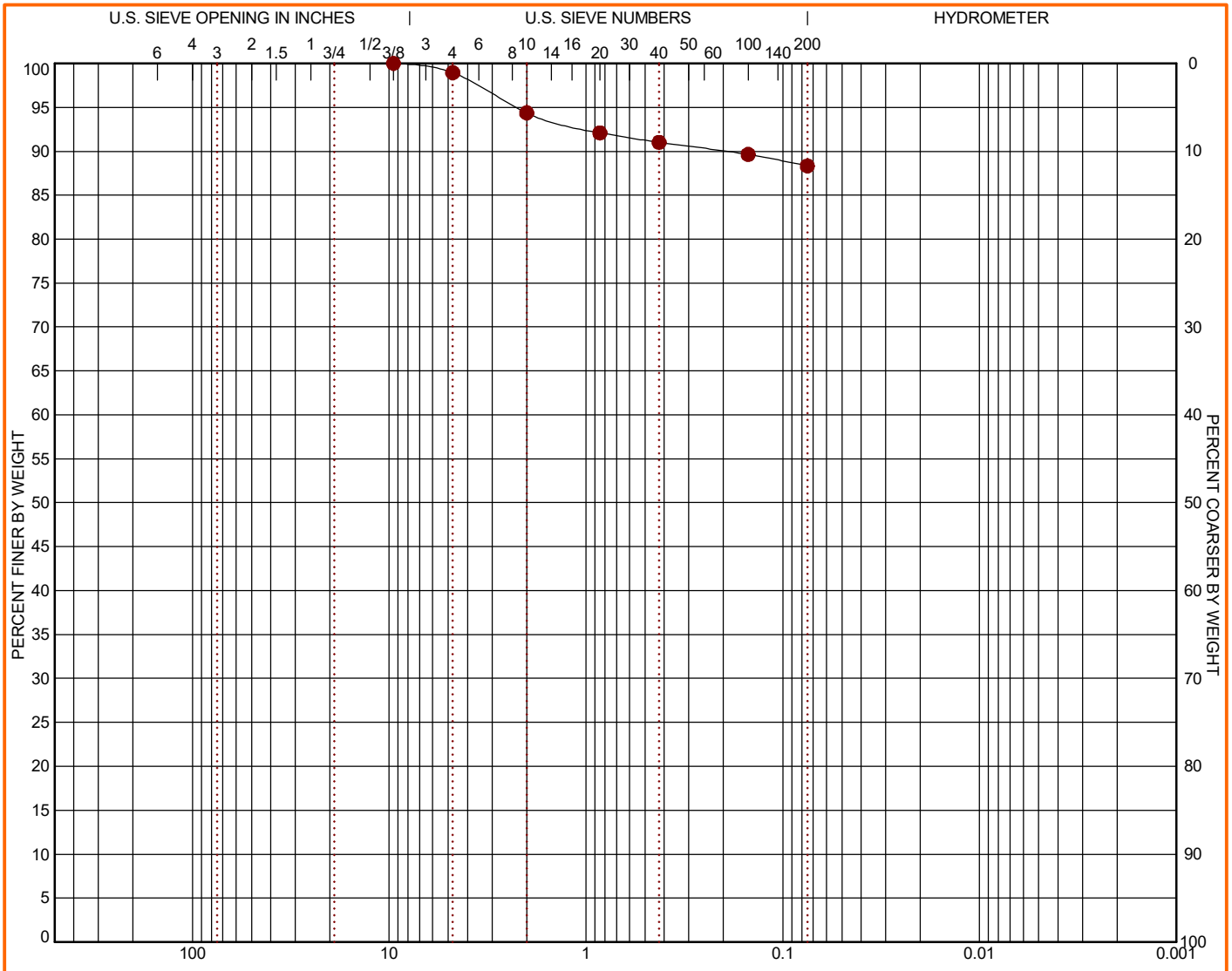
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-4	6 - 8	0.0	1.1	10.6		88.3		CH

GRAIN SIZE			
	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	98.94				
#10	94.36				
#20	92.09				
#40	91.01				
#100	89.64				
#200	88.33				

SOIL DESCRIPTION	
●	FAT CLAY (CH)

REMARKS	
●	SS=275.3ppm

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

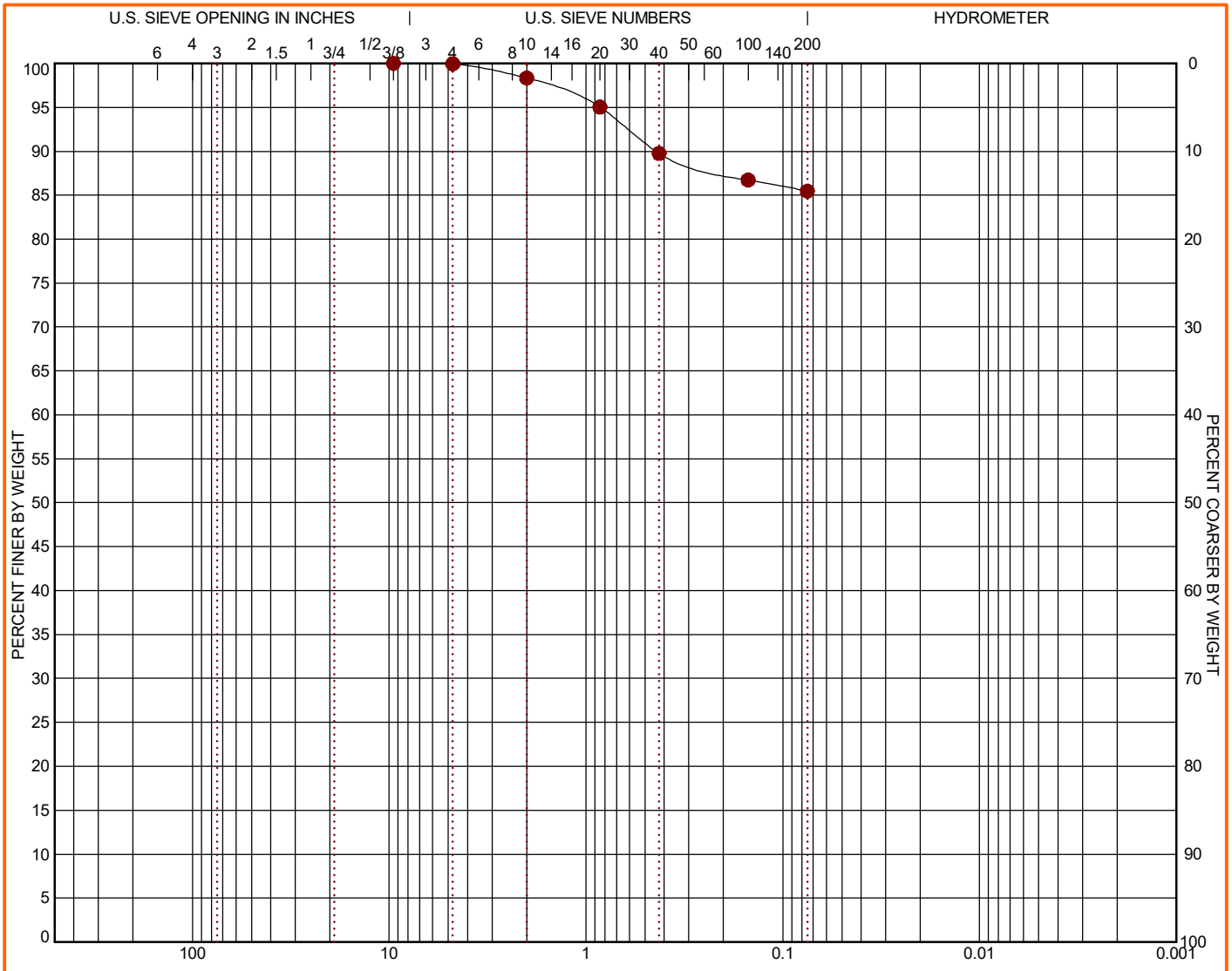
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-6	4 - 6	0.0	0.0	14.5		85.5		

GRAIN SIZE			
	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	99.95				
#10	98.34				
#20	95.03				
#40	89.75				
#100	86.72				
#200	85.47				

SOIL DESCRIPTION
●

REMARKS
● SS=80ppm

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

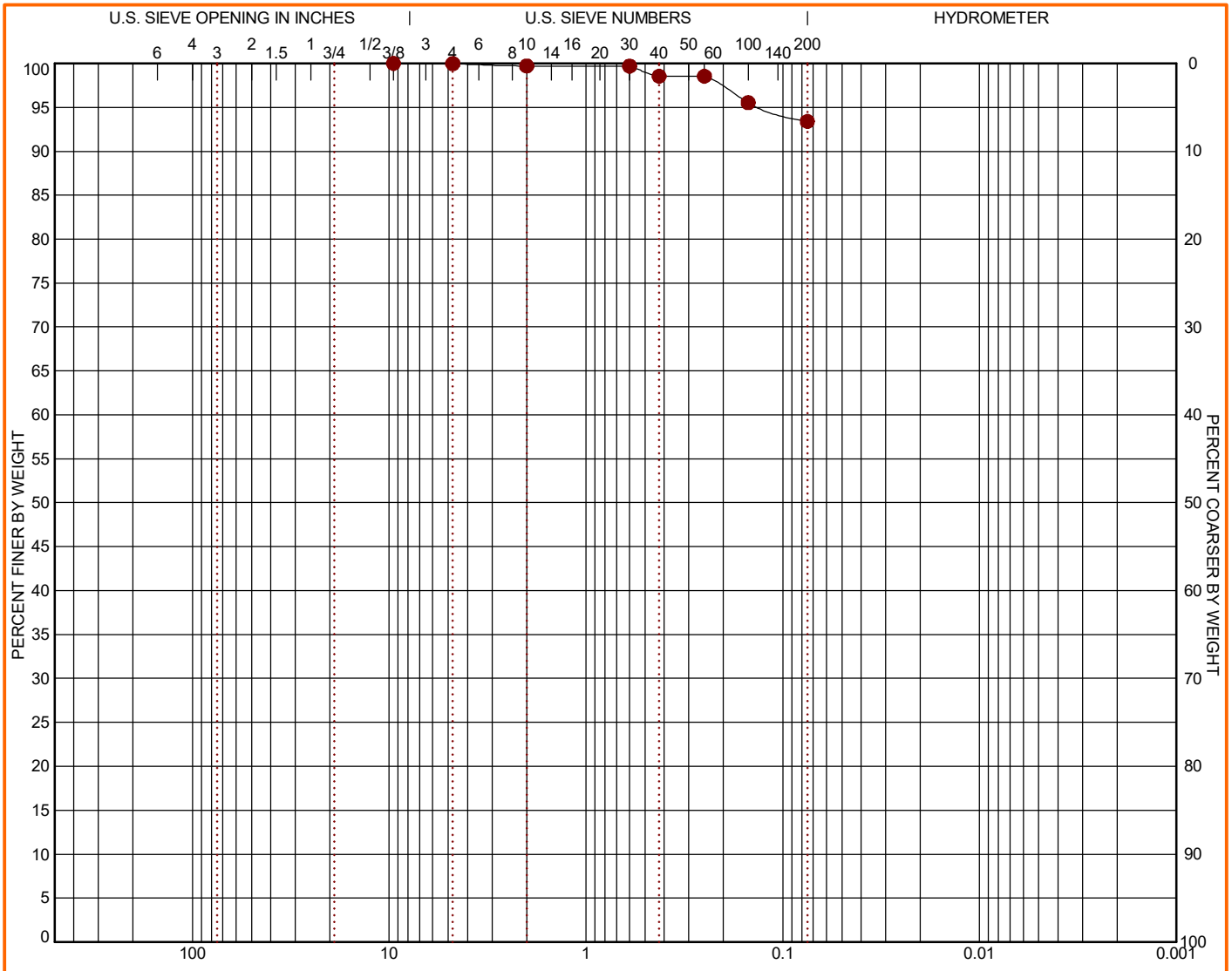
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-8	2 - 4	0.0	0.0	6.6		93.4		CH

GRAIN SIZE			
	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	99.97				
#10	99.71				
#30	99.69				
#40	98.54				
#60	98.54				
#100	95.52				
#200	93.39				

SOIL DESCRIPTION	
●	FAT CLAY (CH)

REMARKS	
●	SS=3520ppm

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

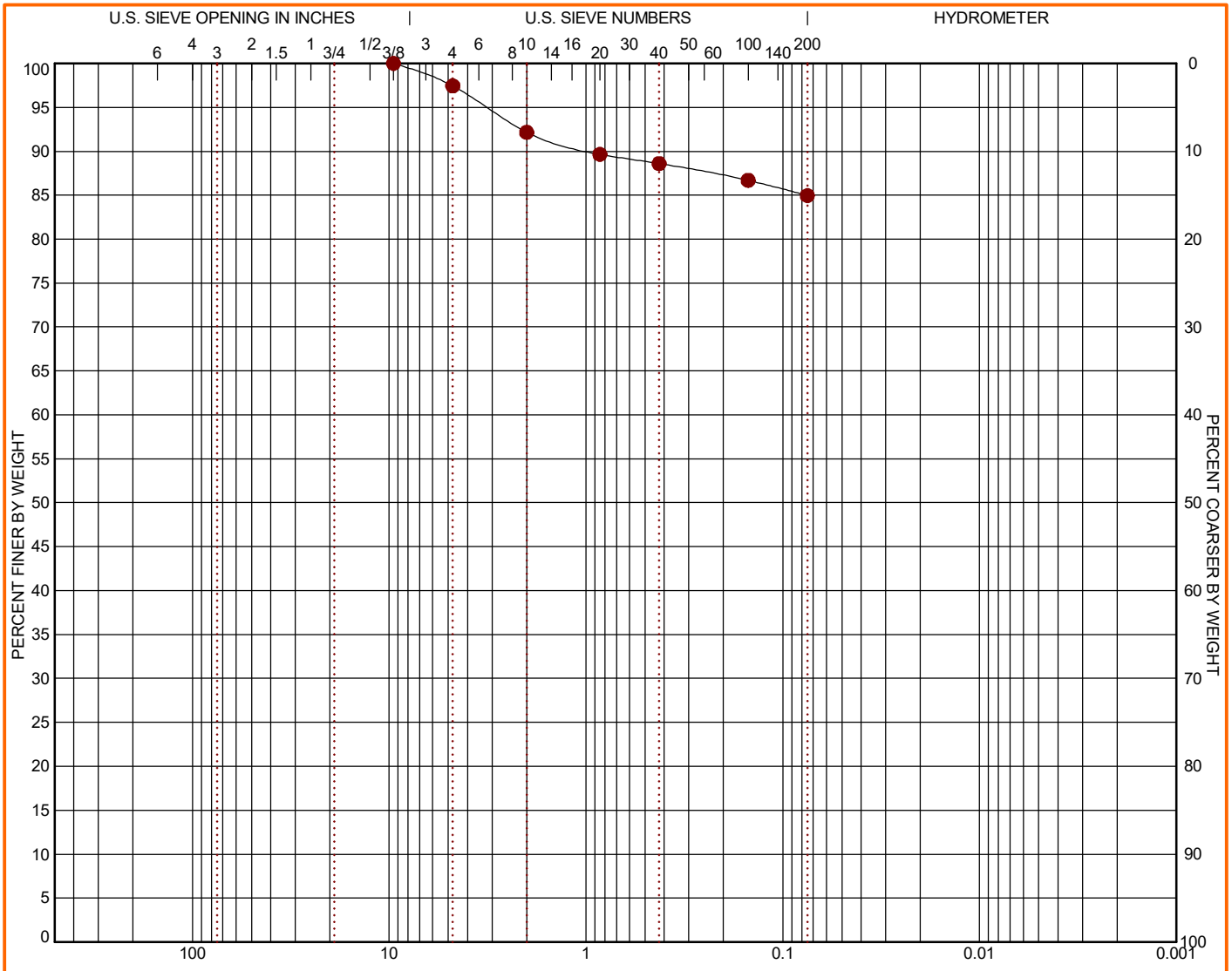
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	TRCN B-11	4 - 6	0.0	2.6	12.5		85.0		CH

GRAIN SIZE			
	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS			
	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	97.45				
#10	92.15				
#20	89.65				
#40	88.6				
#100	86.69				
#200	84.96				

SOIL DESCRIPTION	
●	FAT CLAY with SAND (CH)

REMARKS	
●	SS=364.6ppm

PROJECT: West Lucas Road Reconstruction and Widening

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

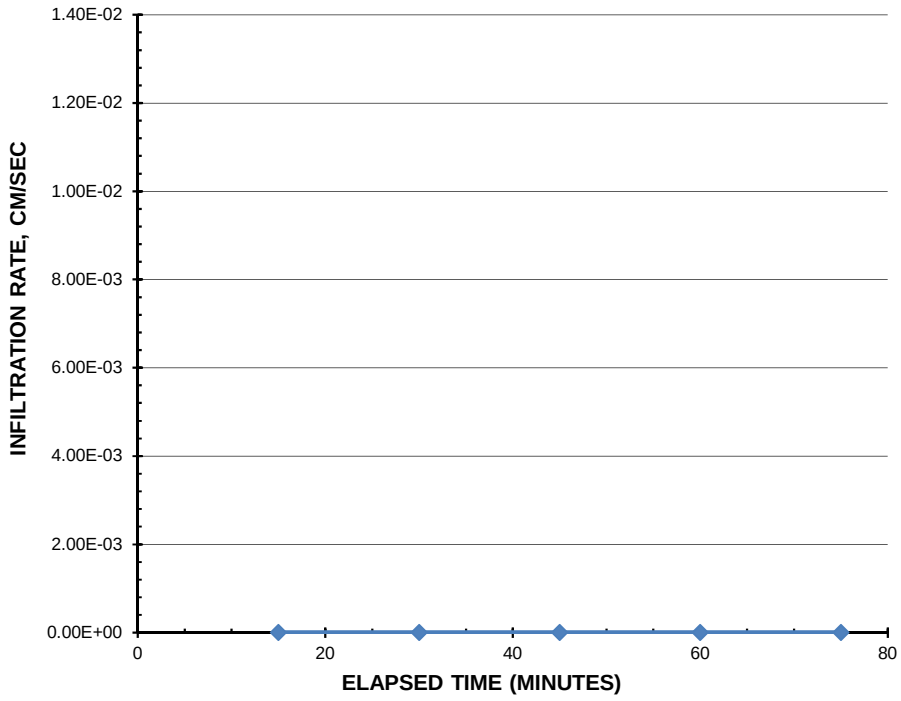
PROJECT NUMBER: 94215036

CLIENT: BCC Engineering Inc.
Bedford, Texas

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

DOUBLE-RING INFILTROMETER TEST RESULTS
Modified ASTM D3385

Elapsed Time, Minutes	Inner Ring Infiltration Rate,cm/sec
15	0.00E+00
30	0.00E+00
45	0.00E+00
60	0.00E+00
75	0.00E+00

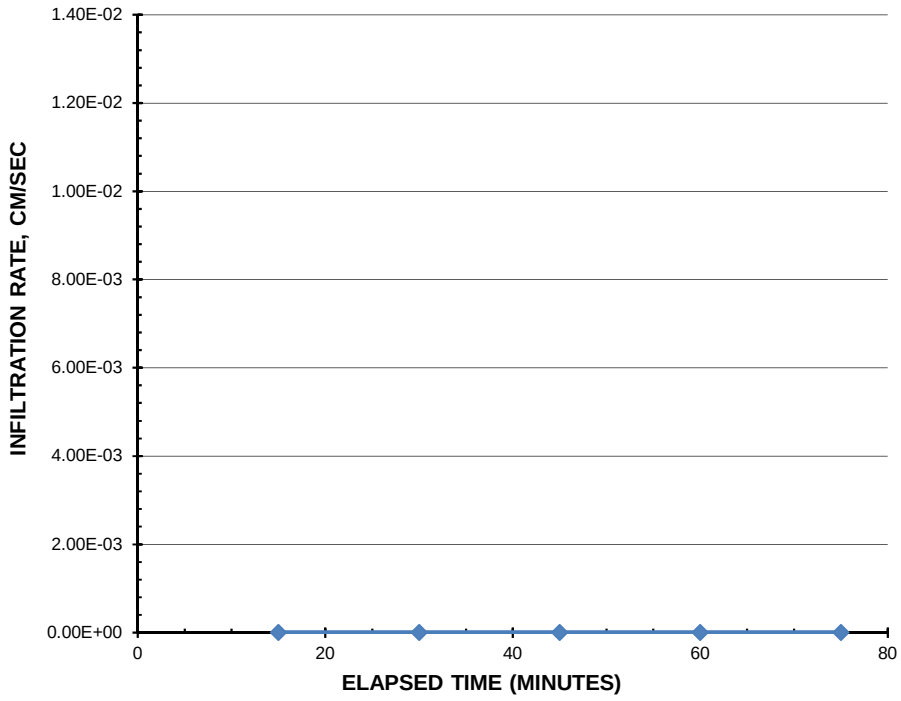


PROJECT INFORMATION	
PROJECT NAME:	West Lucas Road Reconstruction and Widening
PROJECT NUMBER:	94215036
LOCATION:	West Lucas Rd, Lucas, Texas

TEST DESIGNATION:			DRI-1
Location: Lat/long	33.08540, -96.61169	DEPTH:	7 inches
INNER RING DIA.:	6 inches	OUTER RING DIA.:	12 inches
DATE PERFORMED:	5/2/2021	PERFORMED BY:	Sean O' Connor
INFILTRATION RATE:	0.E+00 CM/SEC		

DOUBLE-RING INFILTROMETER TEST RESULTS
Modified ASTM D3385

Elapsed Time, Minutes	Inner Ring Infiltration Rate,cm/sec
15	0.00E+00
30	0.00E+00
45	0.00E+00
60	0.00E+00
75	0.00E+00



PROJECT INFORMATION	
PROJECT NAME:	West Lucas Road Reconstruction and Widening
PROJECT NUMBER:	94215036
LOCATION:	West Lucas Rd, Lucas, Texas

TEST DESIGNATION:			DRI-2
Location: Lat/long	33.08551, -96.60067	DEPTH:	7 inches
INNER RING DIA.:	6 inches	OUTER RING DIA.:	12 inches
DATE PERFORMED:	5/2/2021	PERFORMED BY:	Sean O' Connor
INFILTRATION RATE:	0.E+00 CM/SEC		

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION and NEARBY GEOTECHNICAL DATA

West Lucas Road Reconstruction and Widening ■ Lucas, Collin County, Texas
October 7,2021 ■ Terracon Project No. 94215036

Terracon GeoReport

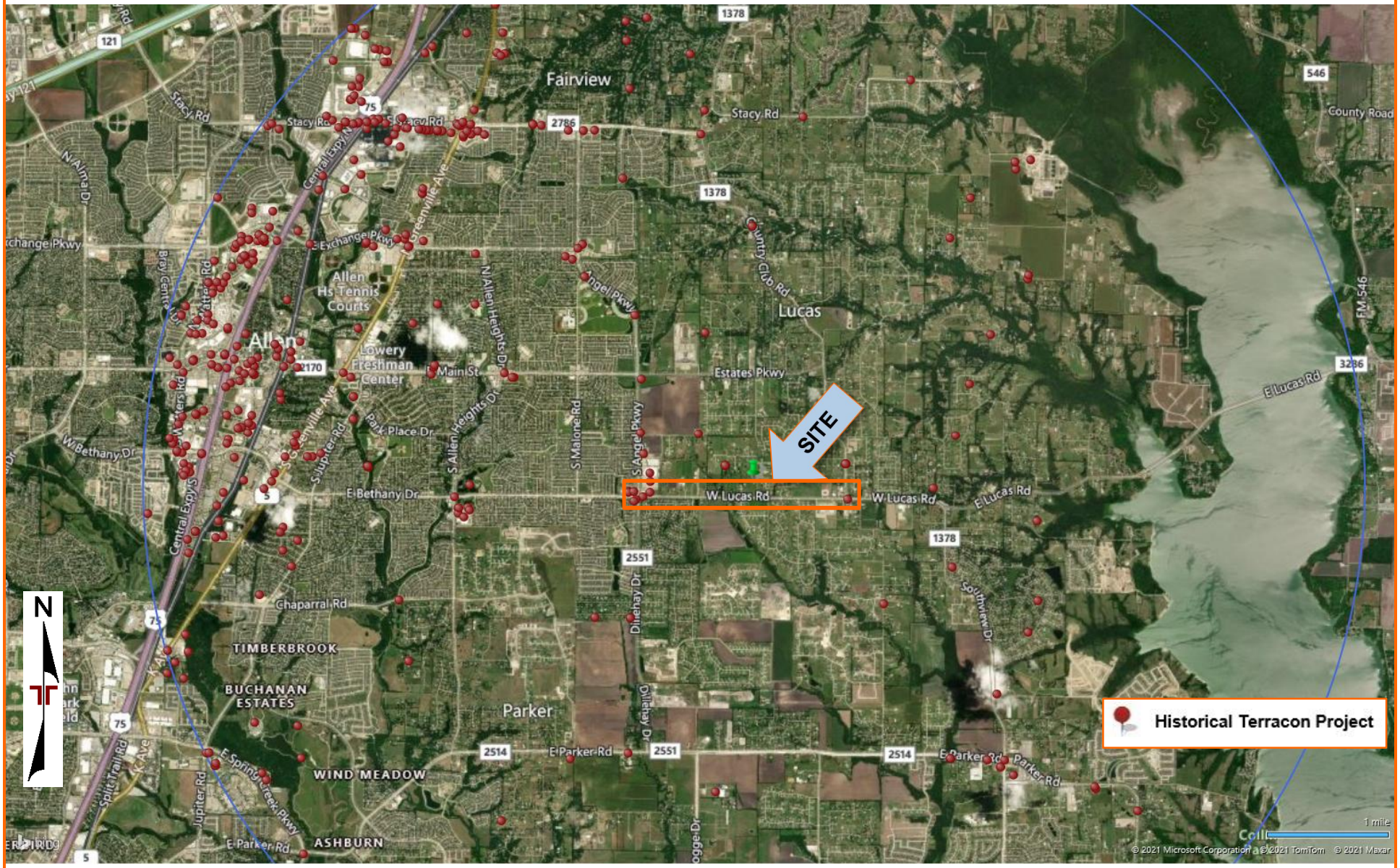


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036

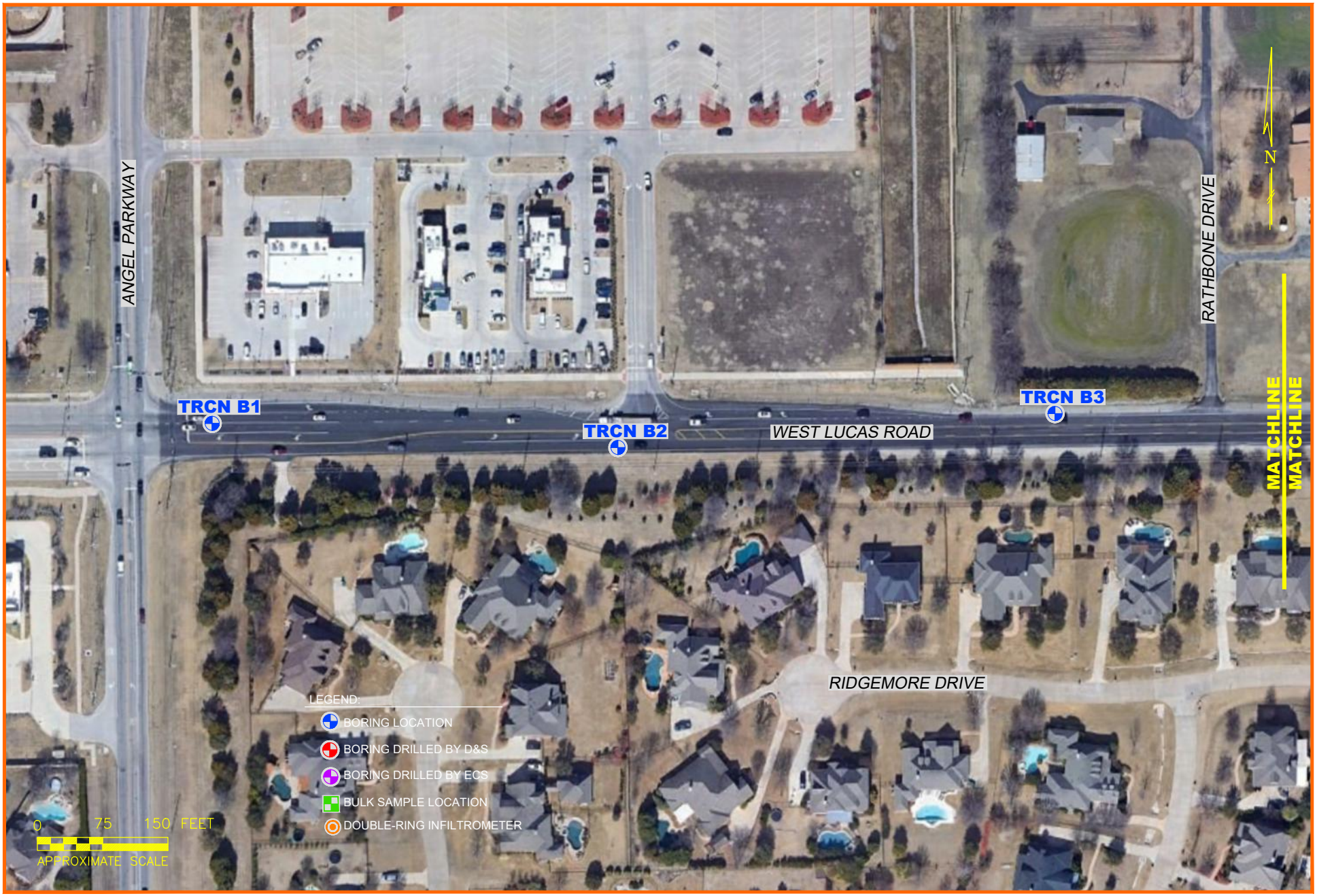


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036

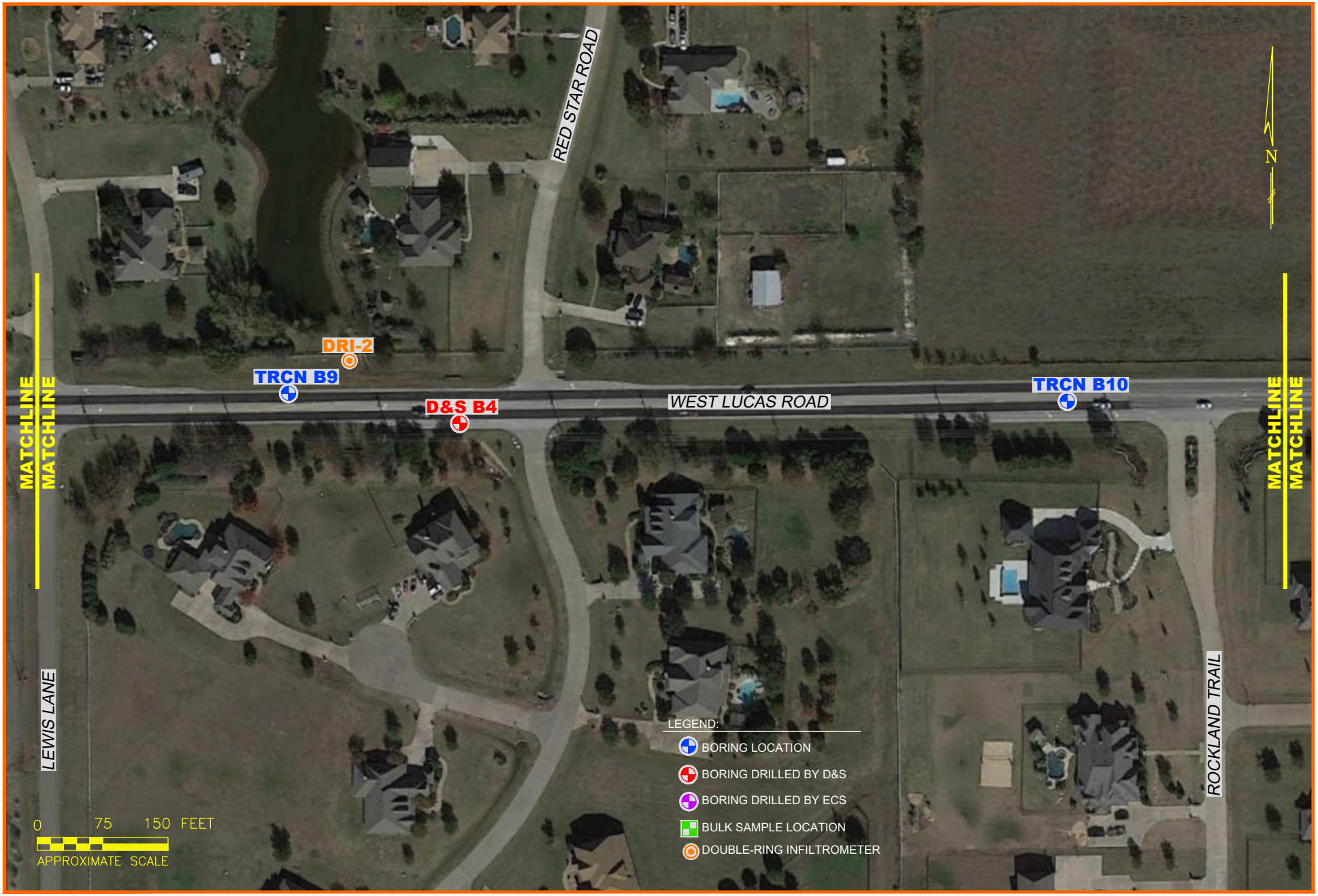


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION PLAN

West Lucas Road Reconstruction and Widening ▪ Lucas, Texas

July 16, 2021 ▪ Terracon Project No. 94215036

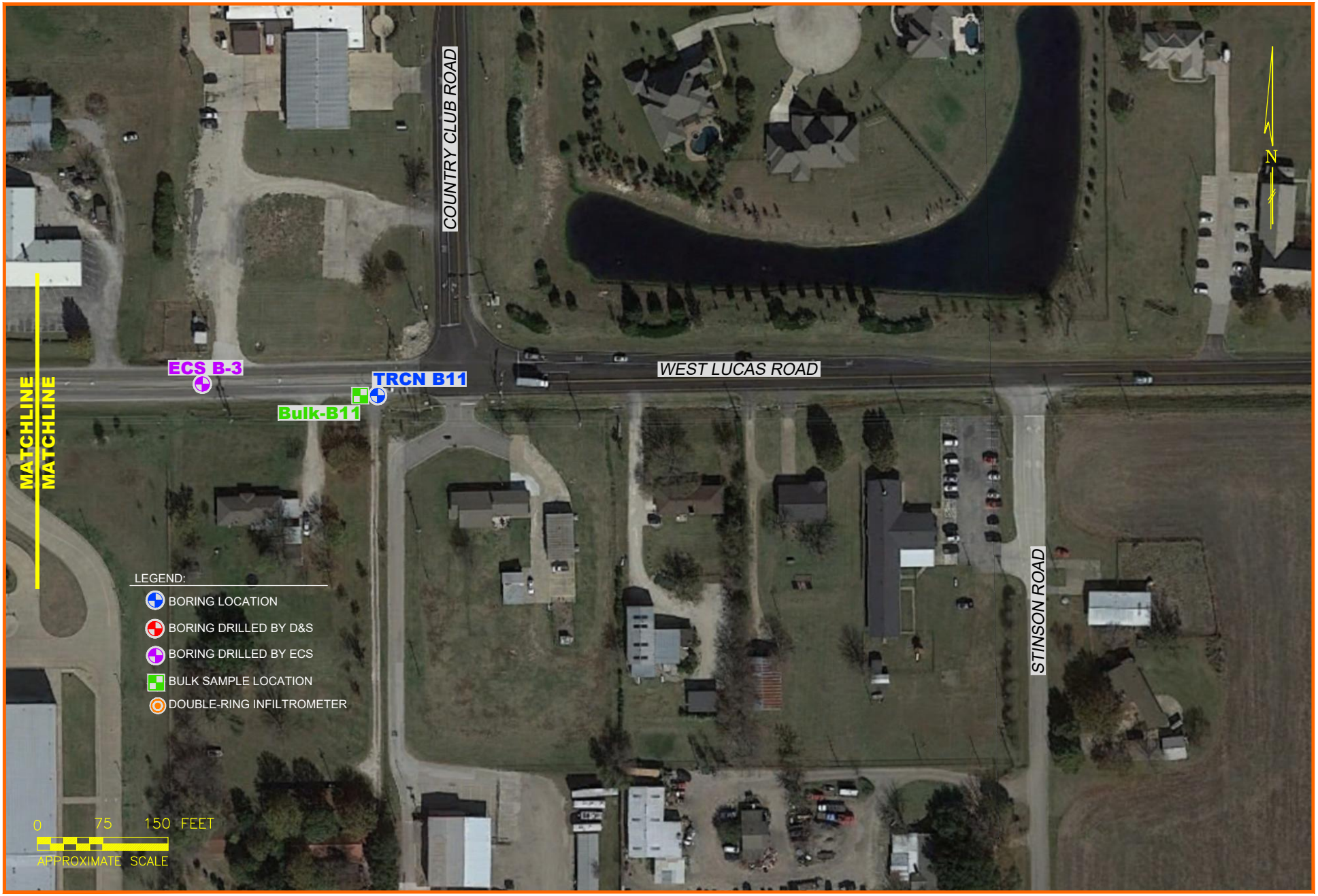


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth, Imagery Date: 11/14/2020.

EXPLORATION RESULTS

BORING LOG NO. TRCN B-1

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0856° Longitude: -96.6198°

Surface Elev.: 646 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			8.75" HAMC OVER 8" LIME TREATED SUBGRADE											
		1.4	644.5											
2			**FAT CLAY (CH)**, dark gray, moist, medium stiff to stiff				1.5 (HP)				26		70-24-46	
		4.0	642											
3			**LEAN CLAY (CL)**, tan, moist, hard	5			4.5+ (HP)				19		41-18-23	84
		6.0	640											
4			**LIMESTONE**, tan, moist, weathered, fractured, interbedded clay lenses				TC=100/1.5"							
		12.0	634	10										
			LIMESTONE, tan and gray, moist, weathered											
		15.0	631				TC=100/0.75"							
			Boring Terminated at 15 Feet	15										

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry augere

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 05-21-2021 | Boring Completed: 05-21-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-2

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc.
Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd
Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0855° Longitude: -96.6183°

Surface Elev.: 642 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
		0.5	641.5											
		5.25" HMAC												
1		**FILL - CLAYEY SAND (SC)**, gray and tan, moist, medium dense, gravelly, some limestone fragments					4.5 (HP)				11		29-15-14	
1							2.5 (HP)	UC	0.86	5.5	18	109		47
		3.5	638.5											
2		**FAT CLAY (CH)**, dark brown and gray, moist, medium stiff to very stiff					2.5 (HP)				26			
2				5			1.5 (HP)				35		69-23-46	
2							1.5 (HP)				35	87		
2							4.5+ (HP)				34		85-23-62	95
		10.0	632	10										
		FAT CLAY (CH), tan, moist, very stiff to hard, shaley, calcareous												
		13.0	629											
4		**LIMESTONE**, tan, moist, soft, weathered, fractured, trace clay lenses												
		15.0	627	15			TC=100/4"							
		Boring Terminated at 15 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-19-2021 | Boring Completed: 04-19-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-3

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0856° Longitude: -96.6167°

Surface Elev.: 637 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
		1.0	636											
			8.875" HMAC OVER 3.5" LIME TREATED SUBGRADE											
1		2.5	634.5				4.5+ (HP)				18		70-25-45	
							4.5+ (HP)							
			FILL - FAT CLAY WITH GRAVEL (CH), tan and gray, moist, hard											
3		4.0	633				1.25 (HP)	UC	1.42	6.5	35	89	28-13-15	
			LEAN CLAY (CL), dark gray, moist, medium stiff, trace to few calcareous nodules											
				5			1.5 (HP)				32			
2							1.5 (HP)				31	91	79-25-54	92
			- hard											
		10.0	627	10			4.5+ (HP)				19			
4			**LIMESTONE**, tan, moist, soft, weathered, fractured, interbedded clay lenses											
		15.0	622	15			TC=100/1.5"							
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry augere

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 05-21-2021 | Boring Completed: 05-21-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-4

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0855° Longitude: -96.6146°

Surface Elev.: 629 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			9" HMAC OVER 11" LIME TREATED SUBGRADE											
		1.7	627.5											
1		2.2	**FILL - CLAYEY SAND (SC)**, gray, moist, dense, gravelly 627				4.5+ (HP)				24			
3		4.0	**CLAYEY SAND (SC)**, dark brown and gray, moist, medium dense, trace to few calcareous nodules and gypsum deposits 625				2.5 (HP)				24		38-17-21	46
2			**FAT CLAY (CH)**, dark brown and gray to brown and tan, moist, stiff to hard, trace to few calcareous nodules and gypsum deposits	5			2.5 (HP)	UC	1.46	5.5	30	91		
							4.0 (HP)				27		83-23-60	88
				10			4.5+ (HP)							
		10.0	619											
			FAT CLAY (CH), tan, moist, very stiff to hard, shaley, calcareous											
		12.0	617											
4			**LIMESTONE**, tan, moist, soft, weathered, fractured, trace clay lenses											
							TC=100/3.5"							
		15.0	614	15										
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-19-2021 | Boring Completed: 04-19-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-5

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0855° Longitude: -96.6126°

Surface Elev.: 627 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			7" HMAC OVER 7" LIME TREATED SUBGRADE											
		1.2	626											
1			**FILL - FAT CLAY (CH)**, gray, moist, stiff to very stiff, sandy, few limestone fragments				4.5+ (HP)				18		58-18-40	
							2.0 (HP)	UC	1.83	4.5	24	88		
		3.0	624											
2			**FAT CLAY (CH)**, dark brown and gray, moist, medium stiff to stiff, trace calcareous nodules				2.0 (HP)				35	87		
				5			1.75 (HP)				36		90-26-64	
							2.5 (HP)				33			
		8.5	618.5				4.5+ (HP)							
4			**LIMESTONE**, tan, moist, soft, weathered, fractured, interbedded clay lenses				TC=75/12"							
				10										
		13.0	614											
			LIMESTONE, tan, moist, soft, weathered, fractured											
		15.0	612				TC=100/0.75"							
			Boring Terminated at 15 Feet	15										

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-20-2021 | Boring Completed: 04-20-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-6

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.0855° Longitude: -96.6101° Surface Elev.: 620 (Ft.) DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
		8.125" HMAC OVER 9.5" LIME TREATED SUBGRADE 1.5 / 618.5											
2		**FAT CLAY (CH)**, dark brown and gray, moist, medium stiff, trace to few calcareous nodules and gypsum deposits				4.5 (HP)				24			
						1.25 (HP)						75-24-51	
			5			1.5 (HP)	UC	2.35	15	23	103		85
						1.5 (HP)				30		69-20-49	
		- hard 9.0 / 611				4.5+ (HP)							
3		**LEAN CLAY (CL)**, tan, moist, hard, shaley, calcareous				4.5+ (HP)				20		44-23-21	78
			10										
4		**LIMESTONE**, tan, moist, soft, weathered, fractured, trace clay lenses 13.0 / 607											
		15.0 / 605	15			TC=100/1"							
		Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-19-2021 | Boring Completed: 04-19-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-7

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0855° Longitude: -96.6073°

Surface Elev.: 617 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
		0.0												
		9" HMAC OVER 6" LIME TREATED SUBGRADE												
		1.3	615.5											
1		**FILL - FAT CLAY (CH)**, gray and brown, moist, medium stiff to very stiff, with gravel, some limestone fragments					4.5+ (HP)				20			
							1.5 (HP)	UC	1.46	4.1	29	95	73-18-55	82
		4.0	613											
2		**FAT CLAY (CH)**, gray and brown, moist, medium stiff to stiff, trace to few calcareous nodules and gypsum deposits		5			1.5 (HP)				24	101		
							2.5 (HP)				23		68-19-49	80
				10			2.5 (HP)				22			
							2.5 (HP)				21		60-18-42	
		15.0	602	15										
		Boring Terminated at 15 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-20-2021 | Boring Completed: 04-20-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-8

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0854° Longitude: -96.6046°

Surface Elev.: 624 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			8.25" HMAC OVER 8" LIMETREATED SUBGRADE											
		1.4	622.5											
2			**FAT CLAY (CH)**, dark brown to brown, moist, stiff to hard, trace calcareous nodules				4.5+ (HP)				22			
							2.0 (HP)				28		70-23-47	93
				5			4.5+ (HP)				24	101		
4		6.0	618											
			LIMESTONE, tan, moist, soft to hard, weathered, fractured, trace clay lenses											
				10			TC=100/3"							
		15.0	609	15			TC=100/1.5"							
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-19-2021 | Boring Completed: 04-19-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-9

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0855° Longitude: -96.6009°

Surface Elev.: 624 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			5" HMAC OVER 5" LIME TREATED SUBGRADE											
		0.8	623											
1			**FILL - CLAYEY GRAVEL WITH SAND (GC)**, gray and tan, dry, dense				4.5+ (HP)				4			19
		2.5	621.5				4.5+ (HP)							
2			**FAT CLAY (CH)**, dark gray, moist, medium stiff to stiff, trace calcareous nodules				1.5 (HP)				16	108		
				5			1.0 (HP)				34		82-26-56	95
							1.25 (HP)		15.36	5.8	34	87		
		9.0	615				2.5 (HP)							
3			**LEAN CLAY WITH SAND (CL)**, tan and light gray, moist, stiff to very stiff, calcareous, some calcareous nodules	10			2.5 (HP)				24		40-17-23	
		12.5	611.5											
4			**LIMESTONE**, tan, moist, soft, weathered, trace clay lenses											
		15.0	609	15			TC=100/4"							
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry augere

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 05-21-2021 | Boring Completed: 05-21-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-10

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0854° Longitude: -96.5979°

Surface Elev.: 625 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
		0.7	624.5											
			2.375" HMAC OVER 6" CONCRETE											
2			**FAT CLAY (CH)**, dark brown to brown, moist, medium stiff, trace calcareous nodules				1.5 (HP)				23			
							1.75 (HP)				31		73-22-51	77
							2.0 (HP)				33	87		
				5			2.0 (HP)				27		73-24-49	
		5.5	619.5											
4			**LIMESTONE**, tan, moist, soft, weathered, fractured, interbedded clay lenses											
							TC=100/5"							
				10										
		11.0	614											
			LIMESTONE, tan, moist, soft to hard, weathered, fractured, trace clay lenses											
							TC=100/1.5"							
		15.0	610	15										
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-20-2021 | Boring Completed: 04-20-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORING LOG NO. TRCN B-11

PROJECT: West Lucas Road Reconstruction and Widening

CLIENT: BCC Engineering Inc. Bedford, Texas

SITE: West Lucas Rd from Angel Pkwy to Country Club Rd Lucas, Texas

LOCATION See Exploration Plan

Latitude: 33.0853° Longitude: -96.5912°

Surface Elev.: 614 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
			10" HMAC											
		0.8	613											
1			**FILL - CLAYEY SAND (SC)**, dark gray, moist, medium dense, with gravel and fat clay layers				1.5 (HP)				12		58-20-38	26
		2.0	612											
2			**FAT CLAY (CH)**, gray and brown, moist, medium stiff to very stiff, trace calcareous nodules				2.0 (HP)				32	89		
				5			2.0 (HP)				26		64-20-44	85
							2.5 (HP)	UC	2.92	7.3	19	112		
							4.5 (HP)							
				10			4.5 (HP)				24			
3			**FAT CLAY (CH)**, tan, moist, hard to very hard, shaley, calcareous, blocky											
		15.0	599	15			4.5+ (HP)				19		60-22-38	
			Boring Terminated at 15 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Dry Augered

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Latitude and longitude were obtained from a handheld GPS device. Approximate boring surface elevation was obtained from the Google Earth maps.

WATER LEVEL OBSERVATIONS

No seepage encountered during drilling

Dry at completion

Terracon
8901 Carpenter Fwy Ste 100
Dallas, TX

Boring Started: 04-20-2021 | Boring Completed: 04-20-2021

Drill Rig: | Driller: Texplor

Project No.: 94215036

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 94215036 WEST LUCAS ROAD W.GPJ TERRACON_DATATEMPLATE.GDT 7/1/21

BORINGS DRILLED BY OTHERS

CLIENT	Job #:	BORING #	SHEET
Birkhoff, Hendricks & Carter, LLP	19:7541	B-1	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
West Lucas Road Improvements	Birkhoff, Hendricks & Carter, LLP

SITE LOCATION

West Lucas Road and Country Club Drive, Lucas, Texas

NORTHING	EASTING	STATION

CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

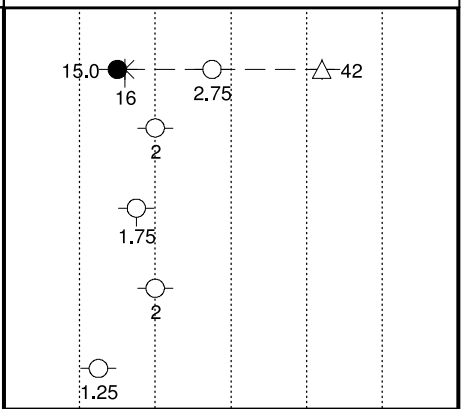
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▰ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 620

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Asphalt Pavement [5"]			
					Base Course [8"]			
	S-1	ST	11	11	(CL) LEAN CLAY, dark brown and light gray, moist, very stiff, with limestone fragments			
	S-2	ST	24	24	(CH) FAT CLAY, dark brown, moist, stiff to very stiff, with calcareous nodules			
5	S-3	ST	24	24				
	S-4	ST	24	24				
	S-5	ST	24	24				
10					END OF BORING @ 10'			
15								
20								
25								
30								



Draft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS☐ WD☒	BORING STARTED 11/30/18	CAVE IN DEPTH N/A
WL(SHW) N/A WL(ACR) N/A	BORING COMPLETED 11/30/18	HAMMER TYPE Auto
WL Dry At Completion	RIG Truck FOREMAN Stratabore	DRILLING METHOD CFA

CLIENT	Job #:	BORING #	SHEET
Birkhoff, Hendricks & Carter, LLP	19:7541	B-2	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
West Lucas Road Improvements	Birkhoff, Hendricks & Carter, LLP

SITE LOCATION: West Lucas Road and Country Club Drive, Lucas, Texas

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

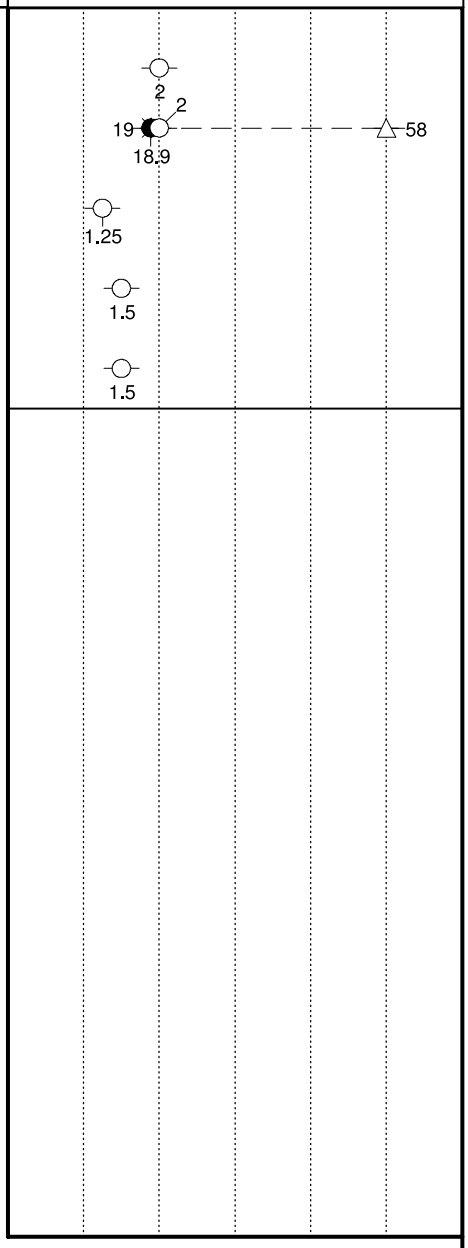
DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 618

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Asphalt Pavement [6"]			
					Base Course [6"]			
	S-1	ST	12	12	(CH) FAT CLAY, dark brown, brown and light gray, moist, very stiff, with limestone fragments			
	S-2	ST	24	24	(CH) FAT CLAY, dark brown, moist, stiff to very stiff, with calcareous nodules			
5	S-3	ST	24	24				
	S-4	ST	24	24				
	S-5	ST	24	24	(CH) FAT CLAY, dark grayish brown, moist, stiff, with calcareous nodules			
10					END OF BORING @ 10'			
15								
20								
25								
30								

Draft



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS☐ WD☒	BORING STARTED 11/30/18	CAVE IN DEPTH N/A
WL(SHW) N/A WL(ACR) N/A	BORING COMPLETED 11/30/18	HAMMER TYPE Auto
WL Dry At Completion	RIG Truck FOREMAN Stratabore	DRILLING METHOD CFA

CLIENT	Job #:	BORING #	SHEET
Birkhoff, Hendricks & Carter, LLP	19:7541	B-3	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
West Lucas Road Improvements	Birkhoff, Hendricks & Carter, LLP

SITE LOCATION

West Lucas Road and Country Club Drive, Lucas, Texas

NORTHING	EASTING	STATION

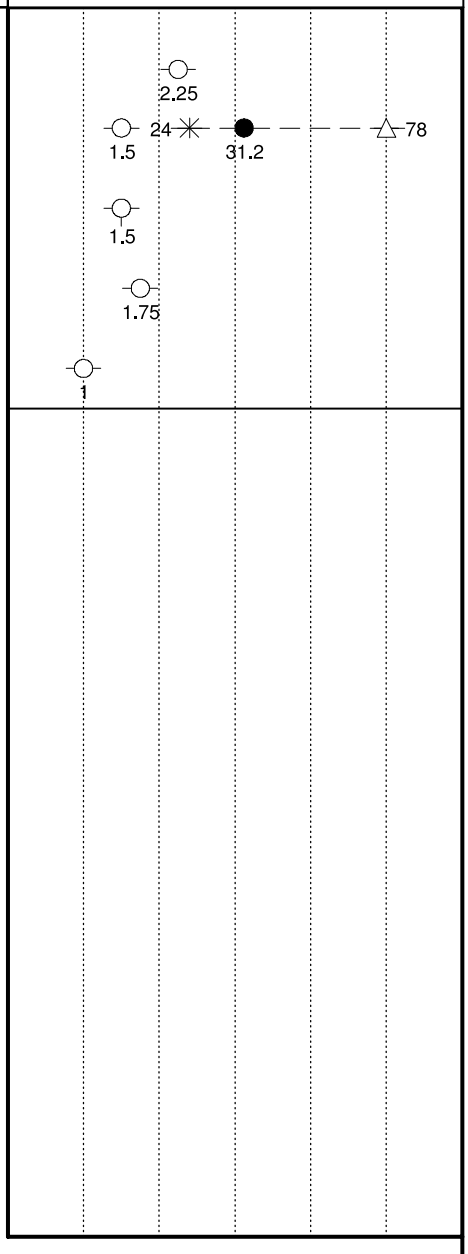
CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					BOTTOM OF CASING ⬛ LOSS OF CIRCULATION 100%			
					SURFACE ELEVATION 612			
					Asphalt Pavement [5"]			
					Base Course [8"]			
	S-1	ST	11	11	(CH) FAT CLAY, dark brown, brown and light gray, moist, very stiff, with limestone fragments			
	S-2	ST	24	24	(CH) FAT CLAY, dark brown, moist, stiff, with calcareous nodules			
5	S-3	ST	24	24				
	S-4	ST	24	24				
	S-5	ST	24	24				
10					END OF BORING @ 10'			
15								
20								
25								
30								



Draft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS☐ WD☒	BORING STARTED 11/30/18	CAVE IN DEPTH N/A
WL(SHW) N/A WL(ACR) N/A	BORING COMPLETED 11/30/18	HAMMER TYPE Auto
WL Dry At Completion	RIG Truck FOREMAN Stratabore	DRILLING METHOD CFA

D&S ENGINEERING LABS

BORING LOG

B1

PROJECT: West Lucas Road Reconstruction
CLIENT: BW2 Engineers, Inc.
PROJECT NUMBER: G16-2134
START DATE: 11/17/2016 FINISH DATE: 11/17/2016
LOGGED BY: Ricky Ybarra (D&S)

LOCATION: Lucas, Texas
GPS COORDINATES: N33.08551, W96.60838
GROUND ELEVATION: Approx. 617 feet
DRILL METHOD: Cont. Flight Auger
DRILLED BY: Miles Sorbel (D&S)

Depth (ft)	Sample Type	Hand Pen. (tsf) or SPT or TCP	Graphic Log	Legend: ■ S-Shelby Tube ☒ N-Standard Penetration ▽ T-Texas Cone Penetration ◧ C-Core ◧ B-Bag Sample ▽ - Water Encountered		REC (%) RQD (%)	MC (%)	Atterberg Limits LL (%)	Atterberg Limits PL (%)	Atterberg Limits PI	Passing #200 Sieve (%)	Total Suction (pF)	Clay (%)	Swell (%)	DUW (pcf)	Unconf. Compr. Str (ksf)
0																
	AU			**ASPHALT;** (1.0")	0.1 ft											
				AGGREGATE BASE; (4.0")	616.9 ft											
					0.3 ft											
				FAT CLAY (CH); very stiff; dark brown; few limestone fragments and calcareous nodules	616.7 ft											
1	S	3.5			1.3 ft											
				End of boring at 1.3'	615.7 ft											
				Notes: -dry during drilling -dry at completion												
2																
3																
4																
5																

D&S ENGINEERING LABS

BORING LOG

B2

PROJECT: West Lucas Road Reconstruction
CLIENT: BW2 Engineers, Inc.
PROJECT NUMBER: G16-2134
START DATE: 11/17/2016 FINISH DATE: 11/17/2016
LOGGED BY: Ricky Ybarra (D&S)

LOCATION: Lucas, Texas
GPS COORDINATES: N33.08544, W96.60394
GROUND ELEVATION: Approx. 622 feet
DRILL METHOD: Cont. Flight Auger
DRILLED BY: Miles Sorbel (D&S)

Depth (ft)	Sample Type	Hand Pen. (tsf) or SPT or TCP	Graphic Log	Legend: ■ S-Shelby Tube ☒ N-Standard Penetration ▽ T-Texas Cone Penetration ◧ C-Core ◧ B-Bag Sample ▽ - Water Encountered	REC (%) RQD (%)	MC (%)	Atterberg Limits LL (%)	Atterberg Limits PL (%)	Atterberg Limits PI	Passing #200 Sieve (%)	Total Suction (pF)	Clay (%)	Swell (%)	DUW (pcf)	Unconf. Compr. Str (ksf)
0				**ASPHALT;** (1.5") 0.1 ft											
				AGGREGATE BASE; (1.0') 621.9 ft											
1	AU			1.1 ft											
				FAT CLAY (CH); very stiff; dark brown; few limestone fragments and calcareous nodules 620.9 ft											
2	S	4.5+													
3	S	4.5+		3.1 ft											
				End of boring at 3.1' 618.9 ft											
4				Notes: -dry during drilling -dry at completion											
5															

BORING LOG

B3

D&S ENGINEERING LABS

PROJECT: West Lucas Road Reconstruction
CLIENT: BW2 Engineers, Inc.
PROJECT NUMBER: G16-2134
START DATE: 11/17/2016 FINISH DATE: 11/17/2016
LOGGED BY: Ricky Ybarra (D&S)

LOCATION: Lucas, Texas
GPS COORDINATES: N33.08544, W96.60278
GROUND ELEVATION: Approx. 624 feet
DRILL METHOD: Cont. Flight Auger
DRILLED BY: Miles Sorbel (D&S)

Legend:
- ■ S-Shelby Tube
- ☒ N-Standard Penetration
- ▽ T-Texas Cone Penetration
- ◧ C-Core
- ◪ B-Bag Sample
- ▽ - Water Encountered

Depth (ft)	Sample Type	Hand Pen. (tsf) or SPT or TCP	Graphic Log		REC (%) RQD (%)	MC (%)	Atterberg Limits LL (%)	Atterberg Limits PL (%)	Atterberg Limits PI	Passing #200 Sieve (%)	Total Suction (pF)	Clay (%)	Swell (%)	DUW (pcf)	Unconf. Compr. Str (ksf)
0	AU			**ASPHALT;** (1.0") 0.1 ft **AGGREGATE BASE;** (4.0') 623.9 ft 0.4 ft											
1	S	3.0		**FAT CLAY (CH);** stiff; dark brown; few limestone fragments and calcareous nodules 623.6 ft 1.4 ft											
2				End of boring at 1.4' 622.6 ft Notes: -dry during drilling -dry at completion											
3															
4															
5															

D&S ENGINEERING LABS

BORING LOG

B4

PROJECT: West Lucas Road Reconstruction
CLIENT: BW2 Engineers, Inc.
PROJECT NUMBER: G16-2134
START DATE: 11/17/2016 FINISH DATE: 11/17/2016
LOGGED BY: Ricky Ybarra (D&S)

LOCATION: Lucas, Texas
GPS COORDINATES: N33.08534, W96.60034
GROUND ELEVATION: Approx. 619 feet
DRILL METHOD: Cont. Flight Auger
DRILLED BY: Miles Sorbel (D&S)

Depth (ft)	Sample Type	Hand Pen. (tsf) or SPT or TCP	Graphic Log	Legend: ■ S-Shelby Tube ☒ N-Standard Penetration ▽ T-Texas Cone Penetration ◧ C-Core ◧ B-Bag Sample ▽ - Water Encountered	REC (%) RQD (%)	MC (%)	Atterberg Limits LL (%)	Atterberg Limits PL (%)	Atterberg Limits PI	Passing #200 Sieve (%)	Total Suction (pF)	Clay (%)	Swell (%)	DUW (pcf)	Unconf. Compr. Str (ksf)
0				**ASPHALT;** (6.0") 0.5 ft											
1	AU			**AGGREGATE BASE;** (9.0') 618.5 ft 1.3 ft											
2	S	3.0		**FAT CLAY (CH);** stiff; dark brown; few limestone fragments and calcareous nodules 617.7 ft 2.3 ft											
3				End of boring at 2.3' 616.7 ft											
4				Notes: -dry during drilling -dry at completion											
5															

D&S ENGINEERING LABS

BORING LOG

B5

PROJECT: West Lucas Road Reconstruction
CLIENT: BW2 Engineers, Inc.
PROJECT NUMBER: G16-2134
START DATE: 11/17/2016 FINISH DATE: 11/17/2016
LOGGED BY: Ricky Ybarra (D&S)

LOCATION: Lucas, Texas
GPS COORDINATES: N33.08534, W96.59689
GROUND ELEVATION: Approx. 624 feet
DRILL METHOD: Cont. Flight Auger
DRILLED BY: Miles Sorbel (D&S)

Legend:
- ■ S-Shelby Tube
- ☒ N-Standard Penetration
- ▽ T-Texas Cone Penetration
- ◧ C-Core
- ◧ B-Bag Sample
- ▽ - Water Encountered

Depth (ft)	Sample Type	Hand Pen. (tsf) or SPT or TCP	Graphic Log		REC (%) RQD (%)	MC (%)	Atterberg Limits LL (%)	Atterberg Limits PL (%)	Atterberg Limits PI	Passing #200 Sieve (%)	Total Suction (pF)	Clay (%)	Swell (%)	DUW (pcf)	Unconf. Compr. Str (ksf)
0				**ASPHALT;** (2.0") 0.2 ft											
	AU			**AGGREGATE BASE;** (8.0') 623.8 ft 0.7 ft											
1	S	3.0		**FAT CLAY (CH);** stiff; dark brown; few limestone fragments and calcareous nodules 623.3 ft 1.7 ft											
2				End of boring at 1.7' 622.3 ft											
3				Notes: -dry during drilling -dry at completion											
4															
5															

PAVEMENT CORE PHOTOS



Photo 1: Pavement Core at Boring TRCN B-1



Photo 2: Pavement Core at Boring TRCN B-2



Photo 3: Pavement Core at Boring TRCN B-3



Photo 4: Pavement Core Hole at Boring TRCN B-4



Photo 5: Pavement Core at Boring TRCN B-5



Photo 6: Pavement Core at Boring TRCN B-6



Photo 7: Pavement Core at Boring TRCN B-7



Photo 8: Pavement Core at Boring TRCN B-8



Photo 9: Pavement Core at Boring TRCN B-9



Photo 10: Pavement Core at Boring TRCN B-10



Photo 11: Pavement Core at Boring TRCN B-11

PAVEMENT CALCULATIONS AND TRAFFIC DATA

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-1	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, CL	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

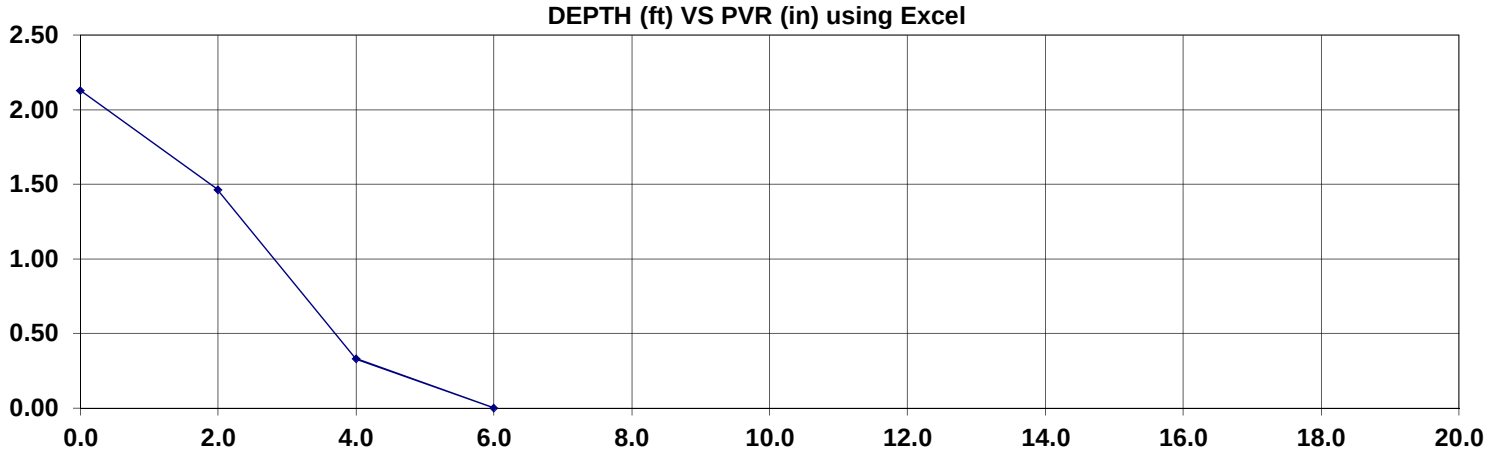
Boring Number:	TRCN B-1	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2.13**
2.0	1.0	70	23.0	34.9		Dry	100.0	46	13.2	16.7	**0.00**	**0.67**	0.67	1.00	1.00	0.67	**1.46**
4.0	3.0	70	23.0	34.9		Dry	100.0	46	13.2	16.7	**0.67**	**1.80**	1.13	1.00	1.00	1.13	**0.33**
6.0	5.0	41	17.2	21.3		Dry	100.0	23	5.7	8.7	**0.91**	**1.24**	0.33	1.00	1.00	0.33	**0.00**
	3.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.24**	**1.24**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-2	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, SC	GRADE:	
MATERIAL NAME:	Clays and Sands		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

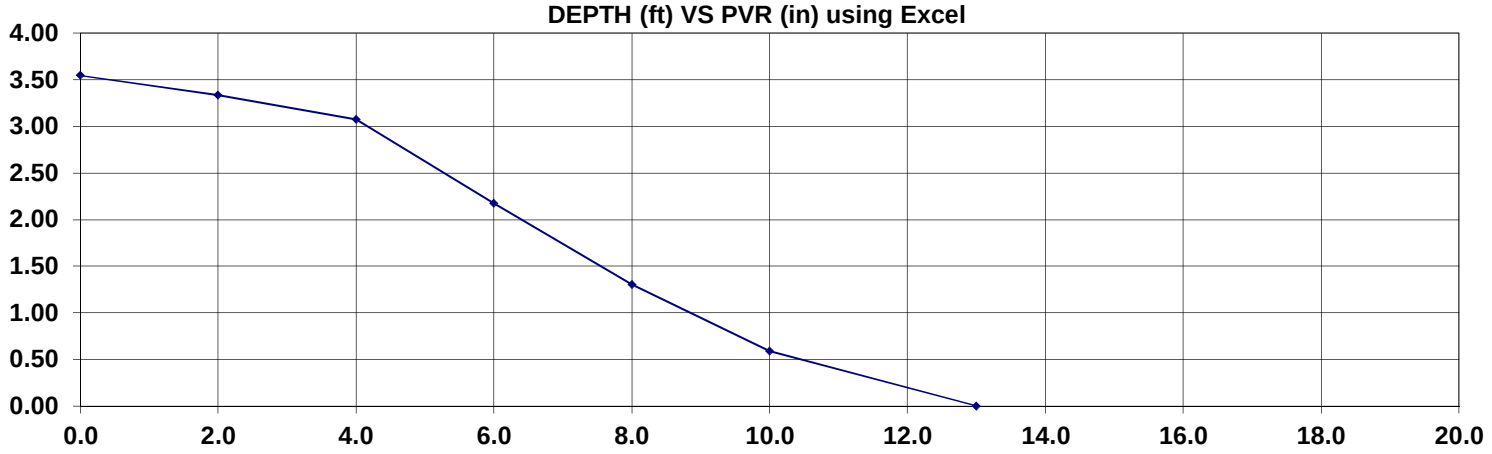
Boring Number:	TRCN B-2	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3.55**
2.0	1.0	29	14.8	15.6		Dry	100.0	14	2.8	5.6	**0.00**	**0.21**	0.21	1.00	1.00	0.21	**3.34**
4.0	3.0	29	14.8	15.6		Dry	100.0	14	2.8	5.6	**0.21**	**0.47**	0.26	1.00	1.00	0.26	**3.08**
6.0	5.0	69	22.8	34.4		Dry	100.0	46	13.2	16.7	**1.80**	**2.70**	0.90	1.00	1.00	0.90	**2.18**
8.0	7.0	85	26.0	42.0		Dry	100.0	62	15.6	19.3	**3.10**	**3.98**	0.87	1.00	1.00	0.87	**1.30**
10.0	9.0	85	26.0	42.0		Dry	100.0	62	15.6	19.3	**3.98**	**4.69**	0.72	1.00	1.00	0.72	**0.59**
13.0	11.5	85	26.0	42.0		Dry	100.0	62	15.6	19.3	**4.69**	**5.28**	0.59	1.00	1.00	0.59	**0.00**
	6.5		9.0	2.0		Dry			0.0	0.0	**5.28**	**5.28**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.28**	**5.28**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.28**	**5.28**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.28**	**5.28**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-3	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, CL	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

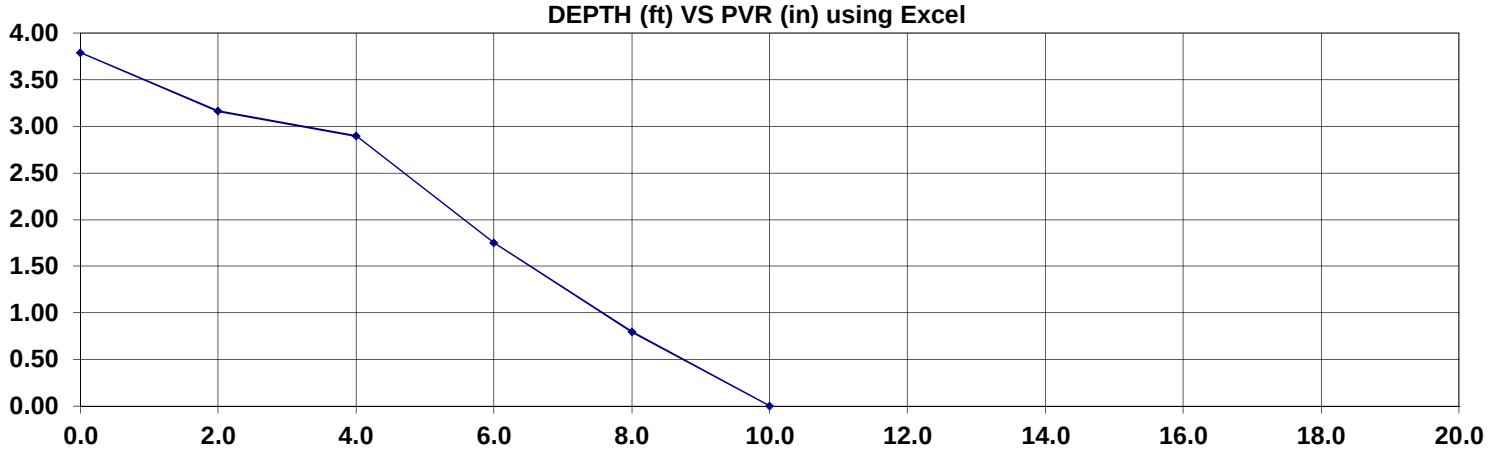
Boring Number:	TRCN B-3	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3.79**
2.0	1.0	70	23.0	34.9		Dry	100.0	45	12.9	16.4	**0.00**	**0.63**	0.63	1.00	1.00	0.63	**3.16**
4.0	3.0	28	14.6	15.2		Dry	100.0	15	3.1	5.9	**0.21**	**0.47**	0.26	1.00	1.00	0.26	**2.90**
6.0	5.0	79	24.8	39.1		Dry	100.0	54	15.8	19.5	**2.16**	**3.31**	1.15	1.00	1.00	1.15	**1.75**
8.0	7.0	79	24.8	39.1		Dry	100.0	54	15.8	19.5	**3.31**	**4.26**	0.96	1.00	1.00	0.96	**0.79**
10.0	9.0	79	24.8	39.1		Dry	100.0	54	15.8	19.5	**4.26**	**5.06**	0.79	1.00	1.00	0.79	**0.00**
	5.0		9.0	2.0		Dry			0.0	0.0	**5.06**	**5.06**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.06**	**5.06**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.06**	**5.06**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.06**	**5.06**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**5.06**	**5.06**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-4	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, SC	GRADE:	
MATERIAL NAME:	Clays and Sands		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

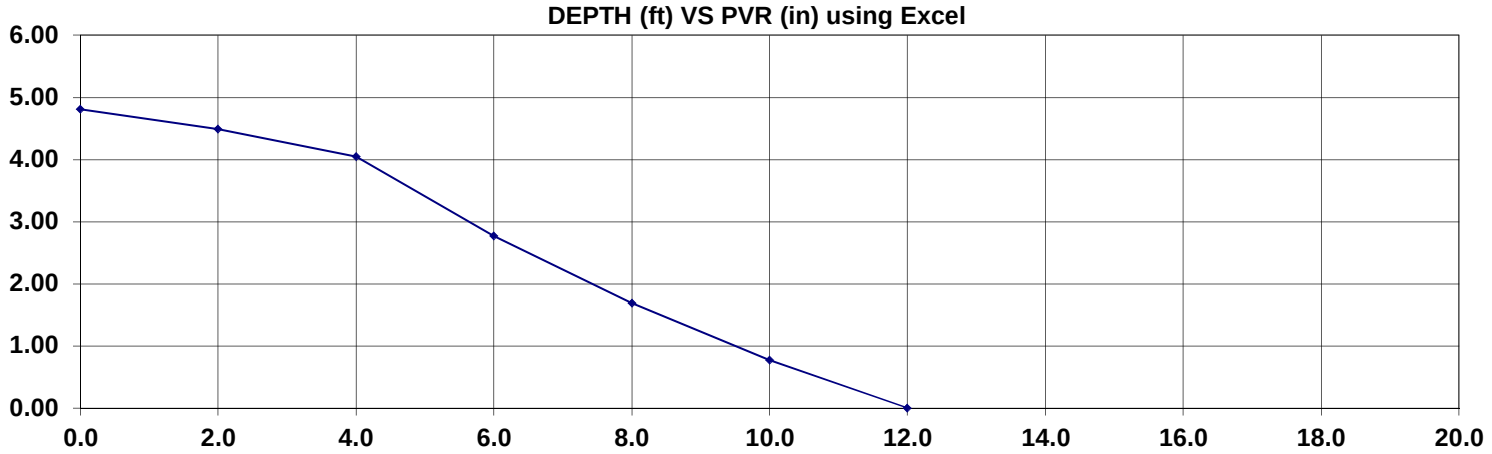
Boring Number:	TRCN B-4	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4.81**
2.0	1.0	38	16.6	19.9		Dry	100.0	21	5.1	8.0	**0.00**	**0.32**	0.32	1.00	1.00	0.32	**4.49**
4.0	3.0	38	16.6	19.9		Dry	100.0	21	5.1	8.0	**0.32**	**0.76**	0.44	1.00	1.00	0.44	**4.05**
6.0	5.0	83	25.6	41.0		Dry	100.0	60	17.8	21.6	**2.34**	**3.62**	1.28	1.00	1.00	1.28	**2.77**
8.0	7.0	83	25.6	41.0		Dry	100.0	60	17.8	21.6	**3.62**	**4.70**	1.08	1.00	1.00	1.08	**1.69**
10.0	9.0	83	25.6	41.0		Dry	100.0	60	17.8	21.6	**4.70**	**5.62**	0.92	1.00	1.00	0.92	**0.77**
12.0	11.0	83	25.6	41.0		Dry	100.0	60	17.8	21.6	**5.62**	**6.39**	0.77	1.00	1.00	0.77	**0.00**
	6.0		9.0	2.0		Dry			0.0	0.0	**6.39**	**6.39**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**6.39**	**6.39**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**6.39**	**6.39**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**6.39**	**6.39**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-5	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

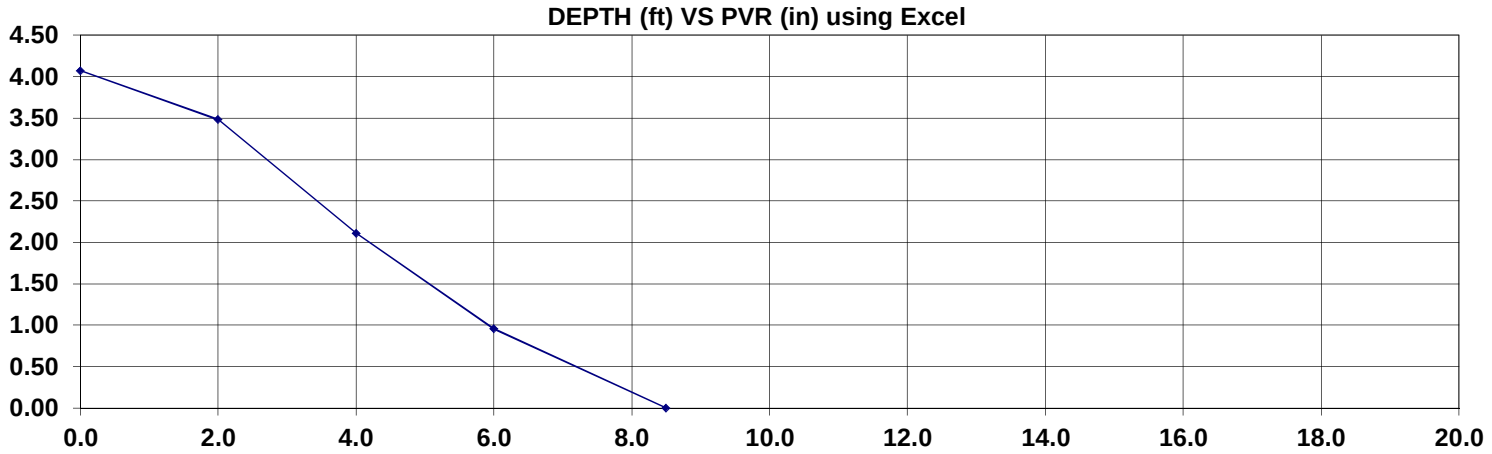
Boring Number:	TRCN B-5	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4.07**
2.0	1.0	58	20.6	29.3		Dry	100.0	40	11.3	14.6	**0.00**	**0.59**	0.59	1.00	1.00	0.59	**3.48**
4.0	3.0	90	27.0	44.3		Dry	100.0	64	16.5	20.2	**0.78**	**2.16**	1.37	1.00	1.00	1.37	**2.11**
6.0	5.0	90	27.0	44.3		Dry	100.0	64	16.5	20.2	**2.16**	**3.31**	1.15	1.00	1.00	1.15	**0.96**
8.5	7.3	90	27.0	44.3		Dry	100.0	64	16.5	20.2	**3.31**	**4.26**	0.96	1.00	1.00	0.96	**0.00**
	4.3		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**4.26**	**4.26**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-6	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, CL	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

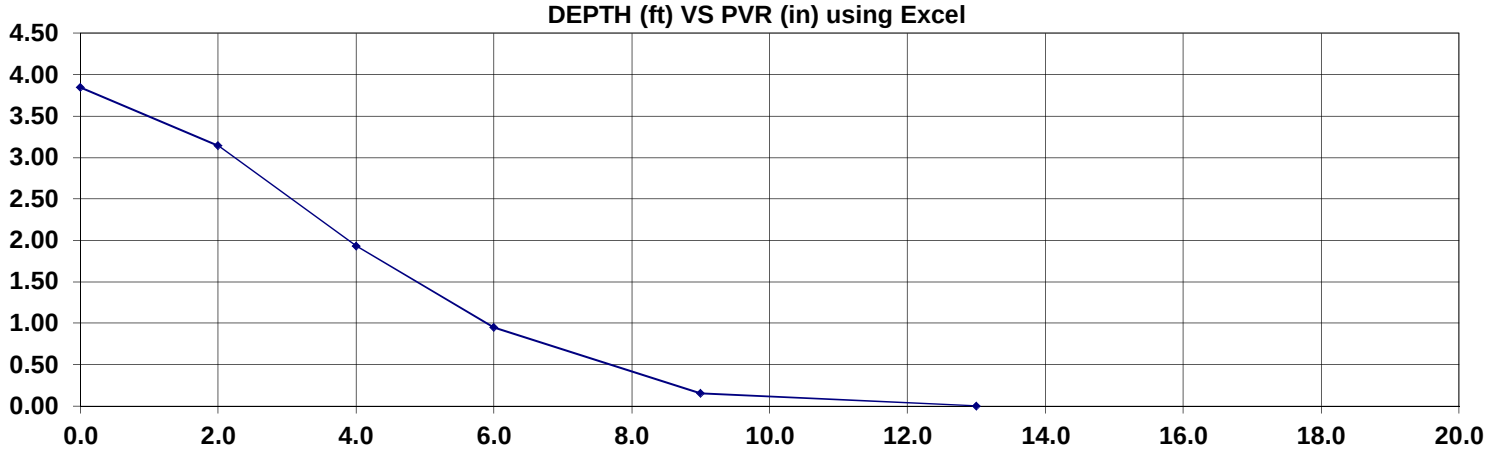
Boring Number:	TRCN B-6	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3.85**
2.0	1.0	75	24.0	37.3		Dry	100.0	51	14.8	18.5	**0.00**	**0.71**	0.71	1.00	1.00	0.71	**3.14**
4.0	3.0	75	24.0	37.3		Dry	100.0	51	14.8	18.5	**0.71**	**1.92**	1.21	1.00	1.00	1.21	**1.93**
6.0	5.0	75	24.0	37.3		Dry	100.0	51	14.8	18.5	**1.92**	**2.90**	0.98	1.00	1.00	0.98	**0.95**
9.0	7.5	69	22.8	34.4		Dry	100.0	49	14.2	17.8	**2.90**	**3.69**	0.79	1.00	1.00	0.79	**0.15**
13.0	11.0	44	17.8	22.7		Dry	100.0	21	5.1	8.0	**1.17**	**1.33**	0.15	1.00	1.00	0.15	**0.00**
	6.5		9.0	2.0		Dry			0.0	0.0	**1.33**	**1.33**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.33**	**1.33**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.33**	**1.33**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.33**	**1.33**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.33**	**1.33**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-7	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

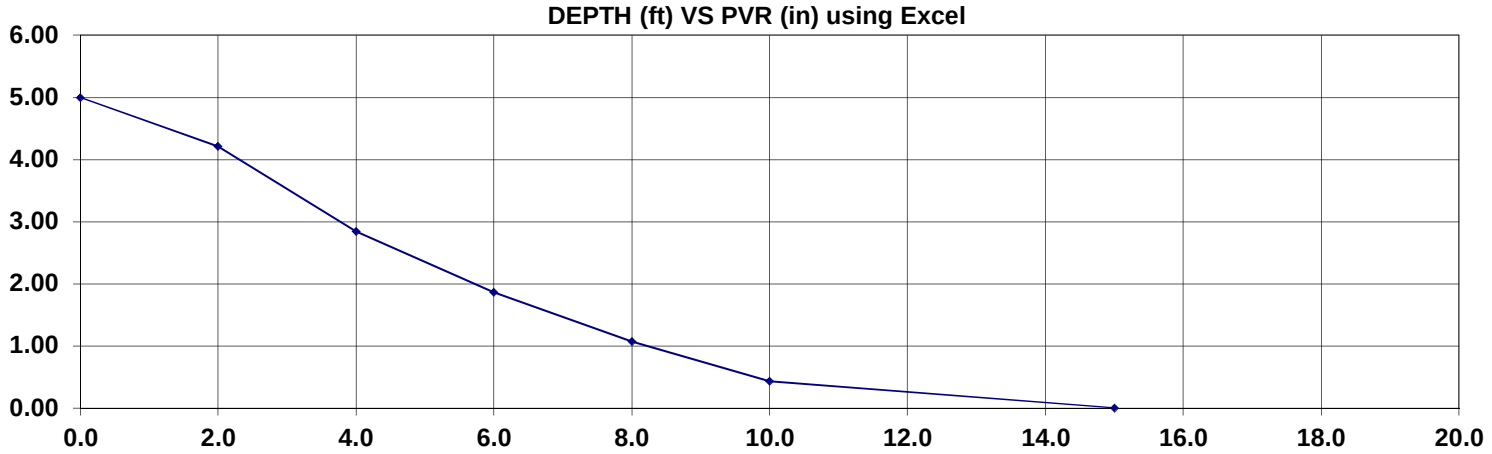
Boring Number:	TRCN B-7	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5.00**
2.0	1.0	73	23.6	36.3		Dry	100.0	55	16.1	19.9	**0.00**	**0.78**	0.78	1.00	1.00	0.78	**4.22**
4.0	3.0	73	23.6	36.3		Dry	100.0	55	16.1	19.9	**0.78**	**2.16**	1.37	1.00	1.00	1.37	**2.84**
6.0	5.0	68	22.6	34.0		Dry	100.0	49	14.2	17.8	**1.92**	**2.90**	0.98	1.00	1.00	0.98	**1.86**
8.0	7.0	68	22.6	34.0		Dry	100.0	49	14.2	17.8	**2.90**	**3.69**	0.79	1.00	1.00	0.79	**1.07**
10.0	9.0	68	22.6	34.0		Dry	100.0	49	14.2	17.8	**3.69**	**4.33**	0.64	1.00	1.00	0.64	**0.43**
15.0	12.5	60	21.0	30.2		Dry	100.0	42	11.9	15.3	**3.25**	**3.67**	0.43	1.00	1.00	0.43	**0.00**
	7.5		9.0	2.0		Dry			0.0	0.0	**3.67**	**3.67**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.67**	**3.67**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.67**	**3.67**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.67**	**3.67**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-8	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

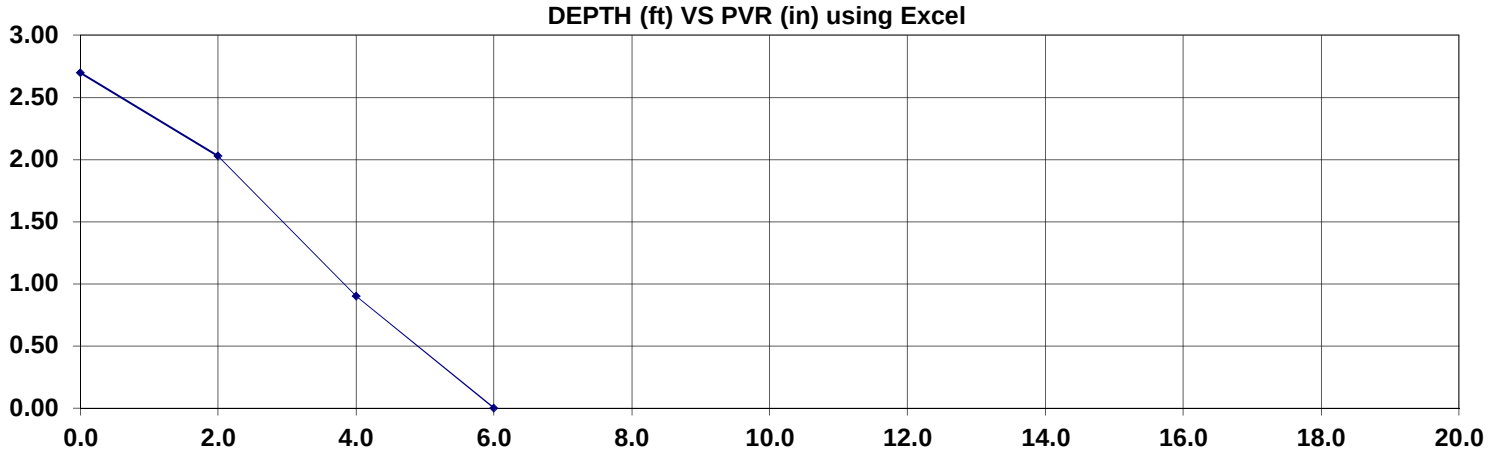
Boring Number:	TRCN B-8	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2.70**
2.0	1.0	70	23.0	34.9		Dry	100.0	47	13.5	17.1	**0.00**	**0.67**	0.67	1.00	1.00	0.67	**2.03**
4.0	3.0	70	23.0	34.9		Dry	100.0	47	13.5	17.1	**0.67**	**1.80**	1.13	1.00	1.00	1.13	**0.90**
6.0	5.0	70	23.0	34.9		Dry	100.0	47	13.5	17.1	**1.80**	**2.70**	0.90	1.00	1.00	0.90	**0.00**
	3.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.70**	**2.70**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-9	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, CL, GC	GRADE:	
MATERIAL NAME:	Clays and Clayey Gravel		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

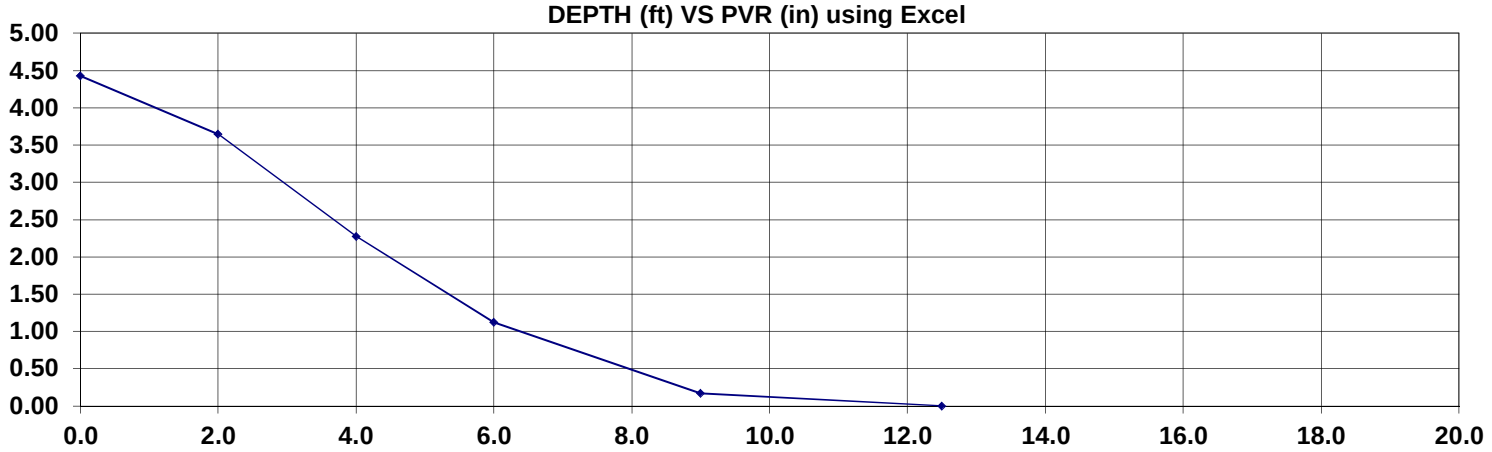
Boring Number:	TRCN B-9	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4.43**
2.0	1.0	82	25.4	40.5		Dry	100.0	56	16.5	20.2	**0.00**	**0.78**	0.78	1.00	1.00	0.78	**3.65**
4.0	3.0	82	25.4	40.5		Dry	100.0	56	16.5	20.2	**0.78**	**2.16**	1.37	1.00	1.00	1.37	**2.27**
6.0	5.0	82	25.4	40.5		Dry	100.0	56	16.5	20.2	**2.16**	**3.31**	1.15	1.00	1.00	1.15	**1.12**
9.0	7.5	82	25.4	40.5		Dry	100.0	56	16.5	20.2	**3.31**	**4.26**	0.96	1.00	1.00	0.96	**0.17**
12.5	10.8	40	17.0	20.8		Dry	100.0	23	5.7	8.7	**1.43**	**1.60**	0.17	1.00	1.00	0.17	**0.00**
	6.3		9.0	2.0		Dry			0.0	0.0	**1.60**	**1.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.60**	**1.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.60**	**1.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.60**	**1.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**1.60**	**1.60**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-10	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH	GRADE:	
MATERIAL NAME:	Clays		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

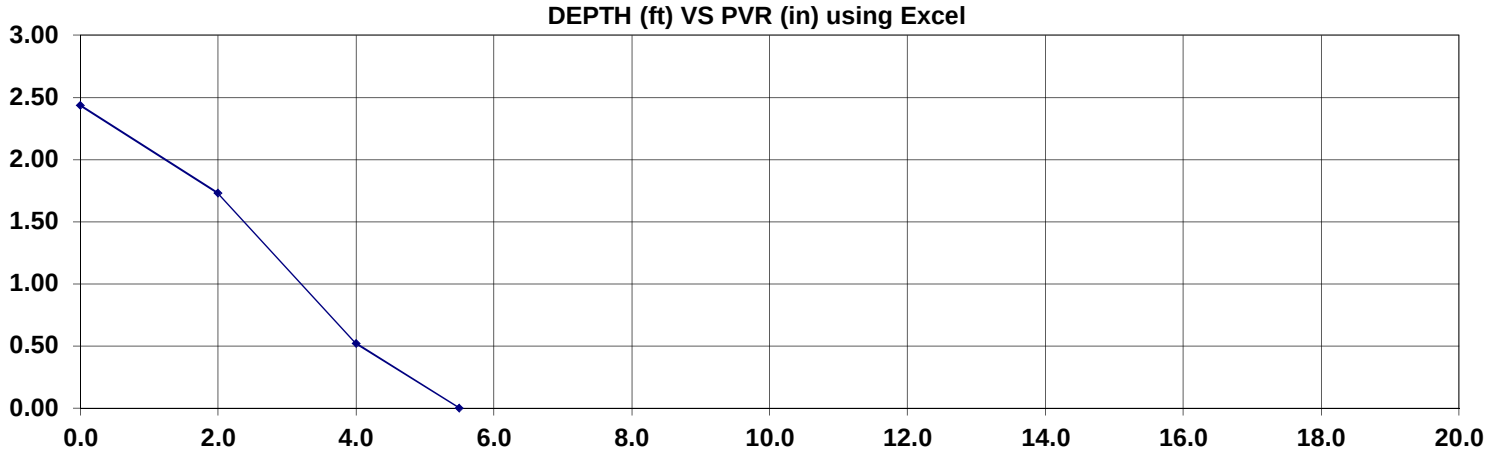
Boring Number:	TRCN B-10	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2.44**
2.0	1.0	73	23.6	36.3		Dry	100.0	51	14.8	18.5	**0.00**	**0.71**	0.71	1.00	1.00	0.71	**1.73**
4.0	3.0	73	23.6	36.3		Dry	100.0	51	14.8	18.5	**0.71**	**1.92**	1.21	1.00	1.00	1.21	**0.52**
5.5	4.8	73	23.6	36.3		Dry	100.0	49	14.2	17.8	**1.92**	**2.44**	0.52	1.00	1.00	0.52	**0.00**
	2.8		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**2.44**	**2.44**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



Remarks:

Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	TRCN B-11	SAMPLED DATE:	
TEST NUMBER:		LETTING DATE:	
SAMPLE STATUS:	Shelby Tube	CONTROLLING CSJ:	
COUNTY:	Collin	SPEC YEAR:	
SAMPLED BY:	Bradford Weddell	SPEC ITEM:	
SAMPLE LOCATION:	West Lucas Rd	SPECIAL PROVISION:	
MATERIAL CODE:	CH, SC	GRADE:	
MATERIAL NAME:	Clays and Sands		
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

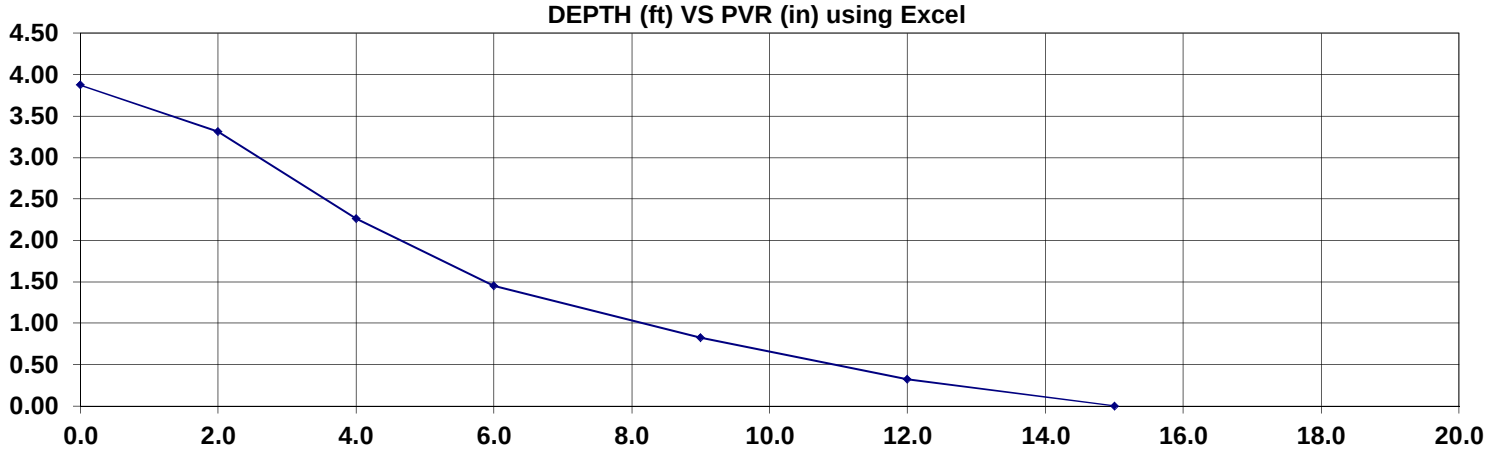
Boring Number:	TRCN B-11	Ground Elevation (z):		Longitude (x):		Latitude (y):	

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3.88**
2.0	1.0	58	20.6	29.3		Dry	100.0	38	10.6	13.9	**0.00**	**0.56**	0.56	1.00	1.00	0.56	**3.32**
4.0	3.0	64	21.8	32.1		Dry	100.0	44	12.6	16.0	**0.63**	**1.68**	1.05	1.00	1.00	1.05	**2.27**
6.0	5.0	64	21.8	32.1		Dry	100.0	44	12.6	16.0	**1.68**	**2.50**	0.82	1.00	1.00	0.82	**1.45**
9.0	7.5	64	21.8	32.1		Dry	100.0	44	12.6	16.0	**2.50**	**3.12**	0.63	1.00	1.00	0.63	**0.82**
12.0	10.5	60	21.0	30.2		Dry	100.0	38	10.6	13.9	**2.61**	**3.11**	0.50	1.00	1.00	0.50	**0.32**
15.0	13.5	60	21.0	30.2		Dry	100.0	38	10.6	13.9	**3.11**	**3.43**	0.32	1.00	1.00	0.32	**0.00**
	7.5		9.0	2.0		Dry			0.0	0.0	**3.43**	**3.43**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.43**	**3.43**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.43**	**3.43**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**3.43**	**3.43**	0.00	0.00	1.00	0.00	**0.00**

Fields are chart inputs | Fields are final answers per layer | Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.



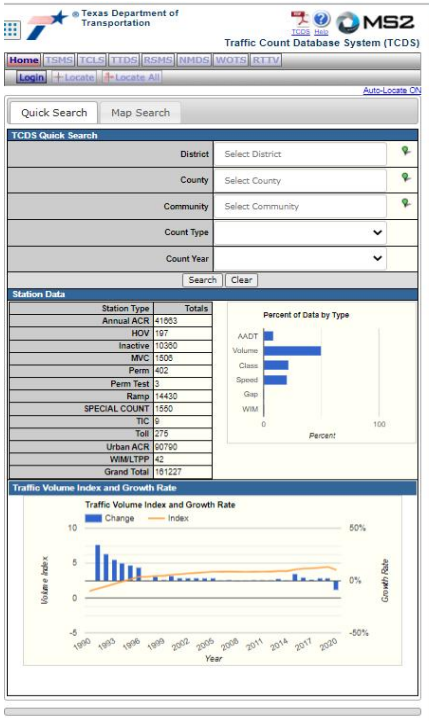
Remarks:

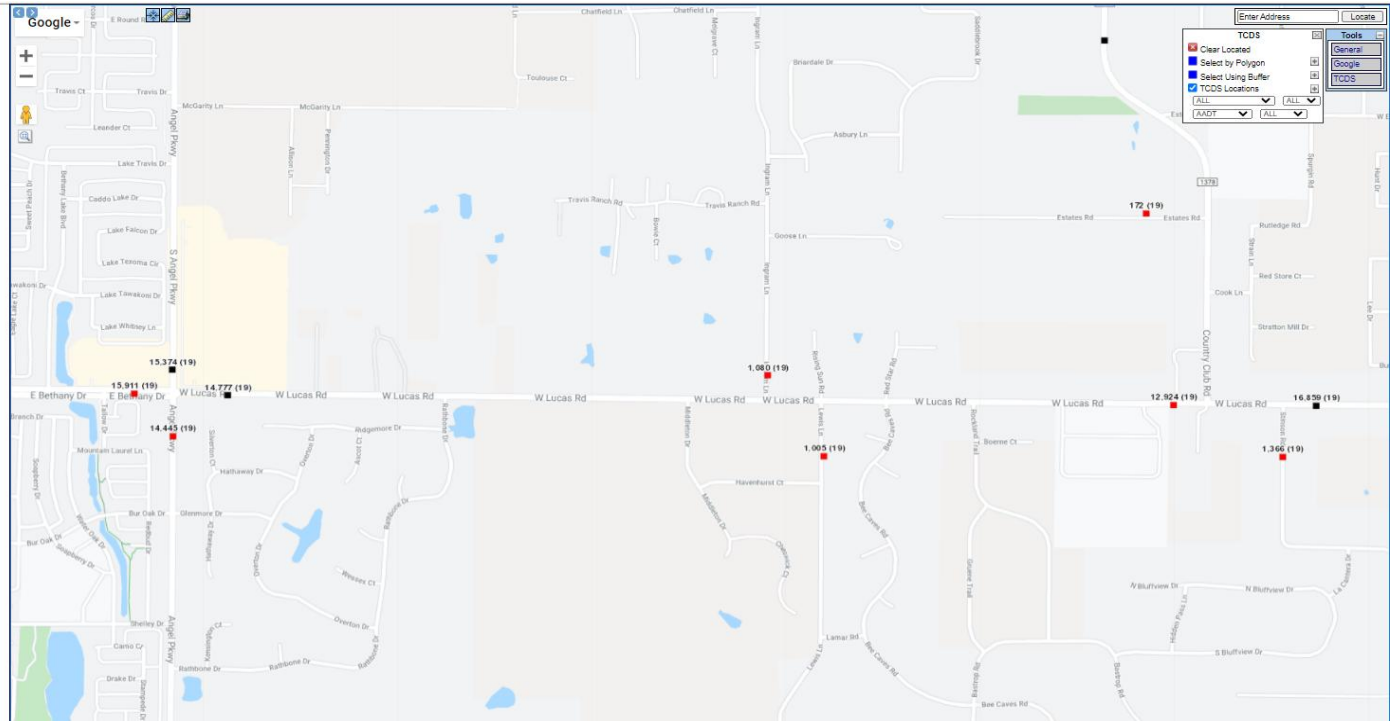
Test Method:	Tested By:	Tested Date:
TX124		

Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By:	TxDOT:	District:	Area:

Authorized By:	Authorized Date:





Year	Station: West Lucas & Angel Pkwy		Station: West Lucas & Country Club Rd	
	Average Annual Dail Traffc (AADT)	Growth rate	Average Annual Dail Traffc (AADT)	Growth rate
2019	14777	11%	12924	10%
2018	13371	6%	11744	3%
2017	12647	-12%	11457	-7%
2016	14405	17%	12378	19%
2015	12352	15%	10444	5%
2014	10721	12%	9926	22%
2013	9608	--	8157	--

Project Mgr:	PT
Tested by:	PT
Checked by:	SPP
Approved by:	SPP

Project No.	94215036
Scale:	N/A
Date:	6/18/2021

Terracon
Consulting Engineers and Scientists
Texas Registration 3272
2501 EAST LOOP 820 NORTH FORT WORTH, TEXAS 76118
PH: (817) 268-8600 Fax. (817) 268-8602

TRAFFIC DATA FROM TxDOT TRFFIC COUNT MAP

West Lucas Road Reconstruction and Widening

Lucas, Texas

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Project Name: West Lucas Road Reconstruction and Widening
Route:
Location: Lucas, Texas
Owner/Agency: City of Lucas
Design Engineer:

Rigid Pavement Design/Evaluation

Concrete Thickness	9.94	**inches**	**Load Transfer Coefficient**	2.90	
Total Rigid ESALs	10,455,500		**Modulus of Subgrade Reaction**	357	**psi/in.**
Reliability	90.00	**percent**	**Drainage Coefficient**	1.00	
Overall Standard Deviation	0.35		**Initial Serviceability**	4.50	
Flexural Strength	570	**psi**	**Terminal Serviceability**	2.50	
Modulus of Elasticity	5,000,000	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	6,000.0	**psi**
Unadjusted Modulus of Subgrade Reaction	357	**psi/in**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	0.0	

Modulus of Subgrade Reaction	357	**psi/in.**

SUPPORTING INFORMATION

UNIFIED SOIL CLASSIFICATION SYSTEM

West Lucas Road Reconstruction and Widening ■ Lucas, Collin County, Texas

October 7,2021 ■ Terracon Project No. 94215036

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ³ 6 and 1 £ Cc £ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A”		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ³ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ³ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ³ 30% plus No. 200 predominantly sand, add “sandy” to group name.

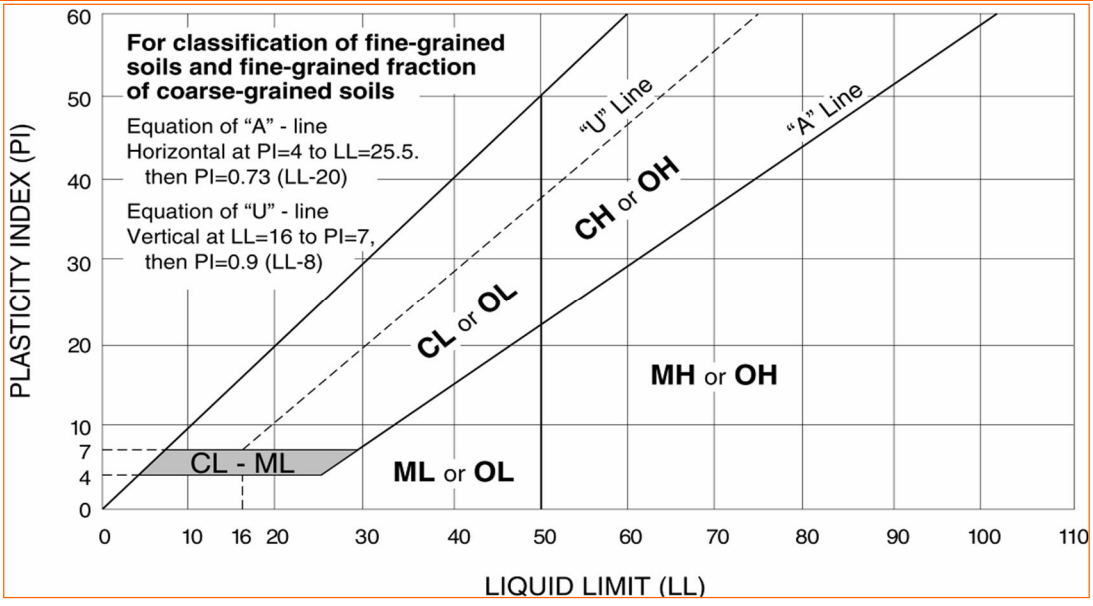
[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ³ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



DESCRIPTION OF ROCK PROPERTIES

West Lucas Road Reconstruction and Widening ■ Lucas, Collin County, Texas

October 7,2021 ■ Terracon Project No. 94215036

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

DESCRIPTION OF ROCK PROPERTIES

West Lucas Road Reconstruction and Widening ■ Lucas, Collin County, Texas

October 7,2021 ■ Terracon Project No. 94215036

WEATHERING	
Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" no discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)	
Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [1]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

1. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) [1]

RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

1. RQD (given as a percentage) = length of core in pieces 4 inches and longer / length of run

Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

CITY OF LUCAS, TEXAS

Mayor or City Manager

ATTEST:

City Secretary (Rev. 03/14)

APPROVED TO FORM

City Attorney

CONTRACTOR

(Signature)

(Type/Print Name and Title)

(Street Address)

(City/State/Zip)

SAMPLE